RELATIONSHIP OF SELECTED SOCIOECONOMIC FACTORS TO SCHOOL FISCAL POLICY

By

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CHAPTER I

INTRODUCTION

Need for the Study

Recent research (Schultz 1961, and Fabricant 1959) has shown that growth in the national economy is directly related to increased investment in education. Obviously it is extremely important that educators and other leaders become familiar with those factors which are associated with optimal school fiscal policy.

According to Norton (1965), there need be no uncertainty about the nation's ability to finance the kind and amount of education we need. "Our economy is fabulously productive. We can pay for anything we really believe is important...." Dr. Norton points out that new economic insights have been developed regarding the productivity of education. In the past, educational expenditures were looked upon as a levy upon the economy, and cuts in school budgets as "savings." Economists today see that the concept of capital formation must be broadened to include education as an addition to human capital.

Johns (1961) expressed a similar opinion in even stronger terms:

> ...we can make our economy of trained people one of plenty instead of one of scarcity by adequate investment in the education of people, and the evidence is clear that we can do this without depriving the private economy of the funds needed for investment in physical capital. National progress and national survival in the future may well depend upon which of the following policies we follow:
>
> We can minimize the investment in education and provide a minimum quality and quantity of education or we can invest

what is needed in education to maximize national progress and the chances of national survival.

Furthermore, Johns and Morphet (1960) have shown that the quality of the instructional program in the schools is strongly related to the financial support of the educational program.

A review of recent research concerned with influences upon school fiscal policy reveals that the determining variables fall into two general categories: (a) socioeconomic--those which are inherent in the society, the culture, and the economic system of the district, and (b) leadership-related--those which are based upon leadership traits of influentials, decision making processes, value systems of the informal power structure, typology of the power structure, and leadership of the superintendent and other educational officials. It is essential that educational administrators know the importance of each group of variables if they are to effectively plan strategies for bringing about desirable change.

Relationship to Cooperative Research Project 2842

This is one of several studies conducted or planned to meet the objectives of United States Office of Education Research Project Number 2842, "The Relationship of Socioeconomic Factors, Educational Leadership Patterns, and Elements of Community Power Structure to Local School Fiscal Policy." The directors of this project, Professors Roe L. Johns and Ralph B. Kimbrough, of the College of Education, University of Florida, selected the states of Florida, Georgia, Kentucky, and Illinois for an intensive three-year study. They have brought together in one design methods for investigating the interrelationships of socioeconomic factors, educational leadership, and community power structure, and the relationship of these factors to local fiscal policy.

The various studies in the overall project seek to answer the following questions:

(a) Have most school districts in the selected states followed relatively consistent patterns of local school fiscal policy as measured by local effort in relation to ability and elasticity of demand for education?

(b) What socioeconomic factors are associated with effort in relation to ability and elasticity of demand?

(c) What unusual changes in fiscal policy have occurred through time in school districts in the selected states?

(d) Are such factors as social power exchanges, economic changes, and changes in educational leadership activities related to changes in local school fiscal policy?

(e) What relationships do the characteristics of community power structure (e.g., monopolistic, competitive, pluralistic) have with the level of local financial effort?

(f) What relationships do the characteristics of educational leadership have with observed variation in effort?

(g) How are certain socioeconomic beliefs among the population, power wielders, and teachers in selected school districts related to financial effort?

(h) Do economic beliefs have a closer relationship than educational beliefs to liberal or conservative fiscal policies among selected school districts?

This study deals with the first three of these questions. It follows-up four separate studies of socioeconomic factors associated with patterns of school fiscal policy in Florida, Georgia, Kentucky, and Illinois, respectively (Hopper, King, Adams, and Quick, each 1965). The present study deals with the same four states as a composite rather than separate entities. The combination should provide more suitable samples for statistical analysis.

It is not suggested that findings from this composite four-state

area can be generalized for either the region or the nation, but it is felt that such findings will be of national interest and importance. Probably no set of individual states could be selected such that a study of the effects of socioeconomic factors, power structure, and leadership in decision making with respect to local school fiscal policy would produce a valid basis for generalizations with national applications. Patterns of behavior with respect to fiscal policy decisions in local districts vary widely for different states and different regions. As James, Thomas, and Dyck (1963) pointed out, "The pattern of relationship between expenditures and our measures of wealth and aspiration seems to vary significantly from state to state, not only in the level of expenditures but also in the strength of the effects of the different explanatory variables."

The four states included in this study do, however, provide a variety of characteristics which might, either directly or indirectly, have some bearing upon decisions with respect to local fiscal policy. Florida is a rapidly growing state with an exclusive county unit school system. It has only 67 school districts, is the wealthiest state in the southeast, and has an emerging two-party system. Kentucky, on the other hand, is a relatively poor state, and it has a mixed county unit-independent city school system, with a total of 206 school districts. Geographically, it is a border state, and it has a two-party political system.

Georgia is average in wealth for the southeast and is more representative of the old South. It has a mixed county unit-independent city school system organization, with 197 school districts. It continues to maintain a one-party political system. Illinois was selected from the

mid-west because of its city-district type of organization with a sufficient number of districts suitable for study. Its per capita personal income was above the national average in 1960, and it has a two party political system.

Statement of the Problem

Since the quality of our instructional programs are dependent upon adequate financial resources, one of the primary objectives of educational administrators should be shaping the school fiscal policies of their districts. In fact, a great amount of time and energy is already being expended for this purpose, but a major portion of this energy will be ineffective unless these administrators know what factors determine fiscal policy. Which categories of determinants are effective and to what degree? Educational leaders must know this in order to develop adequate strategies for needed change.

If fiscal policy is shaped primarily by socioeconomic factors, then administrators will be limited as to how much impact they can bring upon it, for characteristics of the society and the economic system are slow to change. There is little that educational leaders can do within a limited number of years, for example, to markedly change the population density, the employment structure of the community, personal income levels, etc. School administrators need to know which socioeconomic factors are effective and to what degree.

But if socioeconomic variables are not the major cause of variance in school fiscal policy, then educators should look to other factors as possible determinants, such as the leadership-related variables mentioned on page two. These factors, if effective, would lead to quite

different strategies of improvement, and would likely indicate more openness to change. It is, therefore, urgent that school administrators know which variables influence school fiscal policy and to what degree.

Hypotheses

1. Most school districts follow consistent patterns of financial effort and elasticity, yet some make marked changes in relatively short periods of time.

2. High effort districts are more responsive to change in per capita personal income than are low effort districts, such that they invest in education a greater portion of increases in their personal income.

3. There is little association between socioeconomic factors and local school financial effort to support public schools.

4. There is little association between socioeconomic factors and elasticity of demand for education.

5. Local financial support per pupil is significantly related to personal income per capita but not to other socioeconomic variables.

Delimitations

Only districts with populations of 20,000 or more (U. S. Bureau of the Census, 1961) from the states of Florida, Georgia, Kentucky, and Illinois, are included in the study. There are a total of 122 of these districts.

Definition of Terms

Socioeconomic factors.--Characteristic measures of the society, the culture, and the economic system.

School fiscal policy.--Level of support of the public schools.

in this study it is analyzed from three aspects--financial effort, elasticity of demand for education, and financial support per pupil.

Pupil.--Defined in terms of average daily attendance for the purpose of this study.

Fiscal effort.--Local school revenue receipts divided by net effective buying income of the school district.

Local school revenue receipts.--All school financial receipts from local sources, including city, county, and district revenue, whether earmarked for specific purpose (debt service, etc.) or unrestricted.

Net effective buying income.--Total income received by individuals, including salaries, wages, profits, property income, and other personal income, less all tax payments to federal, state, and local governments. This is the same factor defined by the U. S. Department of Commerce as "disposable personal income."

Elasticity of demand for education.--The ratio of percentage change in per pupil revenue receipts to percentage change in per capita net effective buying income. When greater than one, it is referred to as being elastic, less than one, inelastic. A formula somewhat more sophisticated than the above ratio was used in the study. However, it produces essentially the same result. It is described in Chapter II, under "Sources of data."

Review of Related Research

Numerous research studies have sought to identify the causes of variations in school fiscal policy, both from district to district and from one period of time to another. Yet an adequate explanation has not been found.

The research approaches to this problem have varied greatly. Many studies have related financial support to personal income. Hirsch (1959), for example, found that 76 per cent of the variation in per pupil expenditure for 1900 through 1958 was explained by changes in per capita personal income, when the urbanization factor and the ratio of high school enrollment to total enrollment were held constant.

As an alternate approach, he correlated total current expenditures against the following four variables and found that they accounted for 99.8 per cent of the variance from year to year:

1. High school enrollment as a per cent of total enrollment
2. Average daily attendance as a per cent of 5-to 19-year-old population in urban areas
3. Average annual salary of instructional staff members
4. Number of principals, superintendents, and consultants per 1,000 pupils in average daily attendance

Shapiro (1962) also used per capita personal income as an independent variable, in analyzing educational expenditures among different states for the years 1920, 1930, 1940, and 1950. He found it to be highly significant in explaining variations in per pupil expenditure in all areas except in the south, where no significant relationship could be found.

Brazer (1959) used median family income rather than personal per capita income in analyzing the variance in educational expenditures between different urban areas. The following independent variables were used:

1. City population
2. Population growth rate

3. Population density

4. Ratio of school enrollment to total population

5. Ratio of manufacturing employment to total employment

6. Median family income

7. Revenue from state and federal agencies

Only population density and ratio of school enrollment to total population proved to be significant. Although it had been expected that population and manufacturing employment would be important factors, they were found to be relatively immaterial.

Srozer (1959:35) recognized other factors as probably being important influences upon educational expenditures, such as cultural and ethnic background of population elements, climate and topographical features, tax and debt limits, political patterns, etc. And despite the lack of correlation in the above study, he felt educational expenditures are being increasingly influenced by the size of population, both through diseconomies of scale and because of association "with other factors, such as income and population density, which in turn account for the apparent association between per capita expenditures and city size."

Norton (1965) has expressed a similar concern over the effects of city size.

> Many things have caused over-all expenditures to rise rapidly in big cities. One of the most potent factors has been termed 'big-city overburden.' It refers to the fact that the need for public services accelerates as the density of the population rises. The concentration of population increases old needs and spawns new ones. Police and fire protection, traffic control, waste removal, sanitary and health facilities, control of air and water pollution, and welfare measures increase in amount and cost. Some of these services, less needed in rural areas, have an immediate and sharp impact in the crowded city. They cannot be put off. The adequate education of children can be put off--or at least this is often the short sighted decision that is made.

He further pointed out that the lack of fiscal independence often places big city schools at a serious disadvantage in securing needed local revenue. Furthermore, cities often receive smaller allocations of state aid funds per pupil than do other parts of the state.

There has been a growing awareness that metropolitan areas present special fiscal problems which have a strong bearing on educational fiscal policy. Margolis (1961) made comprehensive analyses of such fiscal problems in several metropolitan centers, Lindman (1963) formulated an approach to educational fiscal policy which related educational costs to other governmental costs, and Johns (1963) provided statistical information relating to educational finance in certain urban areas.

Lahnes (1958) investigated the relationship of educational expenditures to size of school and to rate of growth in enrollments. He found that increases in spending were greater in systems with 500 to 1,199 pupils than in smaller or larger systems and the rate of growth in expenditures correlated positively with rate of growth in enrollments.

Wolfbein (1962) found that the occupational structure of the district had a strong relationship to investment in education. Three forces that were found to be particularly influential were (a) continued structural changes in the economy which bring about growth in the service sector, (b) marked increase in professional and technical employment, and (c) substantial rise in productivity, causing relative increases in employment in the service sector and relative decreases in employment in goods-producing enterprises.

There appears to be an inevitable poor fit between the skills and competencies produced by education and the needs of business, industry, and other societal activities. Hanson (1962) found that one of the most

pressing shortages was in the number of qualified teachers, a fact that has profound implications for education. He suggested that insight into the causes of teacher shortages requires an understanding of (a) factors that effect the demand for education, (b) factors that effect teacher supply, and (c) changes in these factors.

Kershaw and McKean (1962) suggested the advisability of modifying the single salary schedule in order to meet the competition of business and industry in critical areas. Unless education successfully competes for the available supply of key personnel, a circular process will work against the financing of our schools: low quality of teaching discourages the public from providing an adequate supply of funds, and inadequate financing in turn leads to obtaining poorer teachers.

Some researchers found that the amount of state aid revenue had a substantial effect upon expenditures per pupil. Renshaw (1960 172), for example, found a significant association between these two variables.

James, Thomas, and Dyck (1963) also studied the effects of state spending upon local support. The usual purpose of state-supported programs is the attainment of equality among school districts, both in per pupil expenditures and in sacrifice required of each taxpayer. They found that this objective was not generally being met because other objectives were leading to conflicting results. Such conflicting objectives include the shifting of revenue demands away from the property tax, and directing expenditures into specified educational activities.

They further hypothesized that demand for education is related to (a) financial ability of the community, (b) aspirations for education among citizens, and (c) the degree of freedom of expression of preferences

by members of the community. Multiple regression techniques reflected that the level of wealth was the factor most closely associated with the rate of educational expenditure. Fiscal independence bore some relationship to local expenditure levels in the different states and in the composite sample, but other governmental variables were rather inconsistently related. When wealth and other variables were held constant, expenditures by state educational agencies proved to be highly influential on local support.

Milner (1963) found that total educational expenditures, including state aid, varied positively with the wealth of the state, the relative number of children, the proportion of pupils in the secondary grades, and the salary level of beginning teachers. Total expenditures were negatively related to population density, fiscal dependency of school agencies, and location in a metropolitan area. Local expenditures varied directly with ability to pay for education and with the costs of services provided.

Roos (1957) analyzed all consumer expenditures rather than just educational ones, and he saw non-income factors as being of primary importance. He found that outlays for science were increasing and that greater proportions of consumer income were being spent for insurance, medical care, education, and other services.

McMahon (1958), in analyzing the 1956 school expenditures in several states, found that 52 per cent of the variations between states were associated with three non-income variables as follows:

1. Proportion of non-whites
2. Proportion of the population consisting of school age children
3. Proportion of children not attending public schools

Many educators have felt that the values and accomplishments of parents constitute perhaps the strongest influence upon the family's demand for education. Brazer and David (1962) used educational attainment of children as the dependent variable, representing the demand for education, in attempting to prove this hypothesis. Using multiple correlation procedures, they found that approximately 40 per cent of the variance in attainment were caused by parental values and accomplishments.

Gentry (1959) chose independent variables such as social climate, years of formal schooling completed by adults, and population change. These accounted for only 30 per cent of the variation in school financial effort, but he suggested other factors observed in his study which may be significant.

Adams, Hopper, King, and Quick (each 1965) chose socioeconomic factors to explain the variability in school fiscal policy between school districts of Kentucky, Florida, Georgia, and Illinois, respectively. Each concluded that none of the following variables: effort, level of support per pupil, and elasticity of demand could be adequately explained by socioeconomic factors. They suggested, however, that other factors may be more influential. These include leadership of the superintendent, typology of the informal power structure, political organization for decision making, etc.

Johns and Morphet (1960) suggested that variations in support levels are caused by a combination of cultural factors and qualities of educational leadership. In line with this suggestion, recent studies have been directed toward community leadership and its related power systems as well as toward cultural elements.

When Hirsch (1959) related school financial support to per capita personal income, as discussed above, he found a nationwide tendency for

the two variables to increase or decrease together. The ratio of percentage change in pupil financial support to percentage change in per capita income is called elasticity of demand for education. Hirsch's study of the period 1900 through 1958 found the elasticity for the nation as a whole to be 1.09. Fabricant (1959), on the other hand, found the state to state elasticity for the United States to be only .78 in 1942. McLoone's (1961) study, however, agrees much more closely with that of Hirsch. He made a state-to-state analysis for the years 1929 through 1958 and found the elasticity to be .99. He made a similar study for the period 1947 through 1958 and found an elasticity of 1.34, indicating increasing interest in education. James (1961) studied almost identical years, 1946 through 1958, and made findings that confirmed McLoone's latter figure.

Burk (1958) cautions the reader that place-to-place data generally produce an elasticity coefficient which is slightly lower than one computed with time series data. This may account for some of the difference between Hirsch's coefficient and those of Fabricant, McLoone and James. Furthermore, the coefficients produced by the latter two tend to confirm each other, providing confidence in the results.

Although the above research has added greatly to our knowledge of school fiscal policy determinants, it has also given evidence that further research is needed.

Organization of the Study

Chapter I includes the introduction to the study, an explanation of the relationship of this study to Cooperative Research Project 2842, the statement of the problem, hypotheses, delimitations, definition of

terms, review of related research and the organization of the study.

Chapter II covers the procedures followed, including the selection of the sample size, the sources of data, and the statistical procedures.

Chapter III describes the analyses made, gives interpretations of the data, and brings out conclusions regarding hypotheses.

Chapter IV summarizes the study and suggests implications for education.

CHAPTER II

PROCEDURES

Size of Sample

Hopper, King, Adams, and Quick (each 1965) studied the socio-economic factors associated with the patterns of school fiscal policy in Florida, Georgia, Kentucky, and Illinois, respectively. Using only those districts with 1960 populations of 20,000 or over in each of the four states, rather small samples were used as follows:

State	Number of Districts Studied
Florida	32
Georgia	33
Kentucky	29
Illinois	28

The results of these individual state studies were both inconclusive and inconsistent. For example, Hopper commented as follows:

> The evidence presented on the relationship of socio-economic variables to local school effort is quite inconclusive. Socioeconomic variables leave a large part of the variation in local effort unexplained. Furthermore, in the same state at different points in time, different socioeconomic variables were not common to the four-state study. The evidence indicates clearly that regression equations to predict local financial effort for schools, using socioeconomic factors as independent variables, are quite unstable, that is, it is impossible to generalize through time in any given state on the relationship with any particular set of socioeconomic variables to local school effort. Nor is it possible to generalize from state-to-state, on the evidence presented in this study.

Similar difficulties were experienced with respect to elasticity of demand for education and for financial support per pupil, and these problems were common to all four studies. An evaluation of the statistical procedures used in these studies has led to the opinion that a composite study of the four-state area may provide a more suitable sample and generate more definite evidence.

Sources of Data

Socioeconomic variables

After reviewing previous research, a panel of doctoral students and faculty members selected 22 variables on the basis of their relevance to school fiscal policy and their suitability for statistical treatment. These were the 22 variables used in the studies of Florida, Georgia, and Kentucky, with the following five factors being unavailable for Illinois: federal revenue receipts per pupil, population per square mile, per cent rural non-farm population, per cent rural farm, and per cent of 6-19-year-olds attending school. The loss of these factors from the composite study has been considered carefully and for the following reasons judged not to materially damage the validity. None of these five factors was shown in the original studies to be significantly related to either financial effort or to local revenue per pupil for the year 1960 in any state studies. Also only federal revenue receipts per pupil was significant with respect to elasticity. Even this relationship was very slight and negative in effect.

The 17 remaining variables are used in this study as listed below. They are numbered so as to be consistant with the symbols in

the previous studies, the elimination of the five listed independent variables accounting for the numbering gaps.

X_1 Average daily attendance in public schools

X_2 Per capita net effective buying income

X_3 Average daily attendance as a per cent of total population

X_5 State revenue receipts per pupil

X_6 Per cent of civilian labor force employed

X_7 Per cent of families with income of $10,000 or more

X_8 Per cent of population that is non-white

X_{12} Per cent of 14-17-year-olds attending public or private schools

X_{13} Median school years completed by 25-or-more-year-olds

X_{14} Per cent of 14-or-more-year-old females in labor force

X_{15} Per cent of employed persons engaged in manufacturing

X_{16} Per cent of population comprised of 25-or-more-year-olds with four years of college education

X_{17} Median family income

X_{18} Per cent of married couples not owning homes

X_{19} Per cent of population comprised of 65-or-more-year-olds

X_{21} Population of district

X_{22} Per cent increase in population over the past decade

These data were available only for decennial years, being dependent upon the federal census (U. S. Bureau of the Census, 1952, 1961). They were collected for 1950 and 1960, for all districts having 1960 census populations of 20,000 or more. The decision to restrict the study to non-rural districts was based primarily on the fact that data on net effective buying income were available only for districts having

populations as great as 20,000. There is, however, an additional advantage to this restriction, in that extraneous effects upon the relationships being studied might otherwise be caused by the sparcity of population in smaller districts, effects with which the original researchers chose to eliminate from consideration.

Financial effort

Financial effort has been defined earlier as total local school revenue receipts divided by net effective buying income. Data for the former factor were obtained from the biennial reports of the state educational superintendents of the respective states. Data for the latter were found in Sales Management Magazine (1950, etc.). Information from both of these sources was summarized in the four independent state studies by Hopper, King, Adams, and Quick (each 1965), where the respective effort computations were made. In order to eliminate the effects of fluctuations from year to year, three year averages were computed for each district: (a) 1949, 1950, and 1951, and (b) 1959, 1960, and 1961. The results of these computations became the sources of data for the present study. To be consistent with the previous studies, E_5 and E_7 are used to symbolize these respective three year averages.

Elasticity of demand for education

This factor was computed by relating change in per pupil local school revenue to change in per capita net effective buying income. The revenue information was obtained from biennial reports of the respective chief state school officers, and the data regarding buying income were available from Sales Management (1950, etc.). Brazer (1959), Fabricant (1959), and Hirsch (1959) have each suggested using a formula for computing elasticity which readily lends itself to statistical

analysis. It consists of the regression coefficient of the independent variable multiplied by the ratio of the mean of the independent variable to the mean of the dependent variable, as follows

$$\text{Elasticity of demand} = \left[\frac{\Sigma XY - \frac{(\Sigma X)(\Sigma Y)}{N}}{\Sigma X^2 - \frac{(\Sigma X)^2}{N}}\right] \cdot \left[\frac{\bar{X}}{\bar{Y}}\right] = \frac{by\, x\bar{X}}{\bar{Y}}$$

X represents the independent variable, which in this case is per capita net effective buying income, and Y represents the dependent variable, per pupil revenue receipts.

When inspecting data for the respective districts from year to year, the original researchers observed a tendency for increases in school revenue to lag increases in personal income. Furthermore, there were fluctuations in revenue from year to year which would cause elasticities of demand trends from year to year to be very erratic. It became obvious that to obtain meaningful coefficients of elasticity, it would be necessary to base the computations on extended periods of time rather than on single years. Therefore, elasticities of demand for education were computed for nine-year periods, 1945 through 1954, and 1953 through 1962, for which symbols 0_3 and 0_5 were chosen to represent the respective values. The same symbols are used in the current study, and the elasticity values computed there provide one of the primary sources of information for the present study.

Revenue receipts per pupil

Receipts per pupil were calculated for the year 1960 and summarized in the separate studies by Hooper, King, Adams, and Quick. The results of their calculations are used in this study, and the symbol R_4

is used here to represent this quotient, as was done in the prior studies.

Statistical Procedures

Comparability of data between states

There was considerable discussion among the judges regarding the advantages of using raw data as opposed to using standardized deviate value equivalent data in the various correlations of the current study. There appeared to be advantages and disadvantages in each approach. Even though raw data provided a much broader range of dispersion, certain extraneous factors were permitted to influence the variables in some states while those in other states were unaffected, thus distorting the result. For example, legal restrictions upon levels of property taxation or fiscal dependence of school districts might have had the effect of lowering the effort levels in some states. Standardizing the data would tend to restrict the impact of such extraneous effects, but it would also narrow the range of dispersions caused by the independent variables, thus eliminating the very effects we are seeking to discover. For this study it was decided to compare the independent and dependent variables in both forms. The multiple correlations were computed first using raw data, and then using standardized data.

Consistency of effort and elasticity

Financial effort E_7, which is a three year average for years 1959 through 1961, was compared with E_5, a similar average for 1959 through 1961. The comparison was made by ranking E_7 by district in descending order, and similarly ranking E_5 in descending order. For

each county, the change in relative rank was calculated, and the results were summarized and interpreted in order to evaluate the consistency of effort over a period of years.

In an identical manner, elasticities of demand for education D_5 and D_3 were compared in order to evaluate consistency over a time base.

Relationship of (a) financial effort to (b) fiscal response to income change

The second hypothesis was tested by relating financial effort, as represented by E_7, the average for years 1959 through 1961, to fiscal response to personal income change, as represented by elasticity of demand D_5, the 1953-1962 average. Pearson r was calculated to determine whether response to change in personal income varied directly with variation in effort. This correlation was thus based on a space relationship rather than a time relationship. The computation was executed both using raw data and using standardized Z values. Each result was evaluated and the two were compared.

Multiple regression technique

It was decided that in investigating the third through fifth hypotheses, a multiple regression analysis would be employed. More specifically, a step-wise multiple regression equations in a step-wise manner. In each step, one additional independent variable was brought into the computation for consideration.

In this program the first step involved selecting the independent variable which has the highest simple correlation with the dependant

variable. In the second and in each subsequent step, the independent variable selected for inclusion was the remaining independent variable having the highest partial correlation with the dependent variable. Thus, in each step, the variable being brought into the computation was the one which made the greatest reduction in error in the analysis of variance, based upon the sum of squares of deviation. The variable selected in this manner was also the one which has the highest F ratio when brought into the regression equation. In fact, the value of the F ratio was used as the criteria for bringing in additional variables. In the present study, an F value of .001 was used as the cutoff point. Variables which, if brought into the computation, would have an F value lower than this, were omitted from the correlation equation.

The program also provided for the rejection of any variable which, after being accepted, experienced a drop in its F ratio down to some pre-selected level due to the effects of later variables being added. In this study the rejection level was established at .00001. This was found to be sufficiently low so that no variable, once having been accepted, was ever rejected. This was consistent with the practice in the studies by Hopper, King, Adams, and Quick (each 1965).

The output from this program included the following information:

1. Prior to computing regression steps--
   a. Mean of each variable
   b. Standard deviation of each variable
   c. Correlation matrix
2. During computation of each regression step--
   a. Multiple correlation after the most recent addition or deletion

b. Standard error of estimate of the multiple correlation

c. Analysis of variance table, showing the following

Degrees of freedom for both the included and the excluded groups of variables

Sum of squares of deviations for each group

Mean square for each group

F ratio for included variables

d. For each included variable:

Regression coefficient

Standard error

F level at or below which deletion will occur

e. For each variable not included:

Partial correlation with the dependent variable

F level required for entry

Tollerance

3. After completion of all regression steps—

Summary table identifying the variables entered and the ones removed, and giving the following information for each.

Multiple correlation after inclusion or deletion

Multiple correlation squared

The increase in the squared multiple correlation caused by entry or removal

The F value required for entry or removal

Significance test

Upon completion of the above computation, certain of the included variables were selected as being significant. Since the present study is a composite of the four previous studies of Florida, Georgia,

Kentucky and Illinois, with the composite results to be compared to these from such original studies, it was felt that the statistical procedures should be identical, at least up to the point where comparisons were to be made. For this reason, the .05 level t-test which was previously used, was similarly applied in the current study, as follows.

First the value of t was determined. Three of the degrees of freedom provided by the 122 cases in the sample had been consumed in computing the means, the standard deviations, and the simple correlations. Consulting a t-table, the t value corresponding to the remaining 119 degrees of freedom was found to be 1.98. Each step of the multiple correlation computation was examined in order, until one was found with a coefficient that failed to equal or exceed 1.98 times its standard error. That step and all subsequent ones were discarded. The variables in the previous step were accepted as being the only ones considered sufficiently significant for consideration. Furthermore, the equation used in such previous step was accepted as the most significant regression equation for predicting the dependent variable. This was the identical significance test applied in the original studies of the four states.

As an additional measure in testing significance, failure to reduce the standard error of the dependent variable was also considered grounds for elimination. Again, this was a precaution applied in the four original studies. However, when it was applied in the current study, no eliminations were effected, for all steps which were otherwise significant did cause reductions in standard error of their respective dependent variables.

Illustration of computer output

Inasmuch as the computerized multiple correlation program was the heart of the procedure used for investigating the hypothesized relationships, the writer felt that the machine output from this program should be illustrated in sufficient detail to clearly show the progression of the computation and the arrangement of information furnished. Therefore, the next several pages are provided as an exact reproduction of a representative portion of the computer output.

Table 1 of the illustration identifies the program being used, summarizes the numbers of cases, variables, and sub-problems, and gives the code number for the time period involved. Then it lists the means and standard deviations for each of the dependent and independent variables. The reader will notice that 20 variables are included, whereas each computation involves only one dependent variable and 17 independent variables, a total of only 18. The reason for this is that the machine program consolidates the regressions of three different dependent variables against the same set of independent variables into one overall problem, having three sub-problems.

For computation efficiency, the machine was programmed to compute simultaneously for all variables, including the three different dependent variables, those constants and relationships which could be handled jointly. The results of these calculations are shown on the first three pages of the illustration. Pages two and three tabulate the simple correlation (Pearson r) of each variable to all other variables. This tabulation is commonly called the correlation matrix and will be referred to accordingly in this report. These simple correlations

TABLE 1

ILLUSTRATION OF COMPUTER OUTPUT
WHEN USING MULTIPLE CORRELATION PROGRAM
ELASTICITY D_5 REGRESSED AGAINST 1960 SOCIOECONOMIC VARIABLES
HEADING AND CONSTANT TABLES

BSL070 - STEPWISE REGRESSION - VERSION OF JUNE 2, 1964
UNIVERSITY OF FLORIDA COMPUTING CENTER

PROBLEM CODE	YEAR 6
NUMBER OF CASES	122
NUMBER OF ORIGINAL VARIABLES	20
NUMBER OF VARIABLES ADDED	-0
TOTAL NUMBER OF VARIABLES	20
NUMBER OF SUB-PROBLEMS	3

VARIABLE	MEAN	STANDARD DEVIATION
1	1.78354	1.06337
2	18213.22115	41724.51953
3	1678.16393	441.64314
4	20.05598	4.39468
5	160.14028	41.26210
6	5.23852	2.22337
7	10.50491	5.07090
8	15.04016	13.24465
9	84.43030	5.83733
10	9.83524	1.34342
11	34.29835	7.55683
12	22.88852	13.06915
13	4.42049	3.72405
14	4746.67212	1291.28027
15	2.23443	0.73864
16	9.54016	3.73092
17	107892.30273	336400.64063
18	36.37048	54.77359
19	1.12090	0.79375
20	168.25732	132.00801

TABLE 2

ILLUSTRATION OF COMPUTER OUTPUT
WHEN USING MULTIPLE CORRELATION PROGRAM
ELASTICITY 0_5 REGRESSED AGAINST 1960 SOCIOECONOMIC VARIABLES
CORRELATION MATRIX

VARIABLE NUMBER	1	2	3	4	5	6	7	8	9	10
1	1.000	-0.012	0.636	0.186	-0.454	-0.211	0.588	-0.338	0.327	0.352
2		1.000	0.276	-0.215	-0.164	-0.004	0.261	0.121	0.083	0.207
3			1.000	-0.318	-0.710	-0.444	0.871	-0.230	0.341	0.706
4				1.000	0.291	0.184	-0.171	-0.014	0.154	-0.264
5					1.000	0.291	-0.629	0.235	-0.120	-0.284
6						1.000	-0.472	-0.138	-0.369	-0.367
7							1.000	-0.220	0.422	0.715
8								1.000	0.074	-0.154
9									1.000	0.480
10										1.000

TABLE 2--CONTINUED

VARIABLE NUMBER	11	12	13	14	15	16	17	18	19	20
1	0.158	0.245	0.447	0.6	-0.543	0.444	-0 008	-0.031	-0 057	0 861
2	0 147	-0.020	0.044	0 159	0.124	0.002	0 984	0.115	0.034	0 155
3	0.538	0.238	0.632	0.837	-0.557	0.220	0.264	0.131	0.106	0 847
4	-0 182	0 071	-0.188	-0 166	0.117	-0.149	-0.239	-0 103	-0.000	-0.217
5	-0.446	-0.447	-0.354	-0.685	0.247	-0.086	-0 182	0.139	-0 154	-0 649
6	-0.683	-0.285	-0 345	-0.495	0 311	0.109	-0.005	-0.235	-0.311	-0 326
7	0 506	0.217	0.639	0.874	-0.502	0 079	0 249	0.240	0.114	0 749
8	0 387	-0.281	-0.116	-0.347	0.397	-0.125	0 058	0.027	0.031	-0.333
9	0.450	0.126	0.362	0 384	-0.324	0.239	0.057	0.191	0 245	0.300
10	0.417	-0 109	0 610	0.604	-0.571	0 107	0 165	0.514	0 083	0 520
11	1.000	0.337	0.358	0 492	-0.145	-0.026	0.137	0.101	0.330	0.346
12		1.000	-0.097	0 440	-0.069	-0.100	0 011	-0 188	0.294	0 237
13			1.000	0 488	-0 459	0 170	0.049	0.077	0 013	0 637
14				1.000	-0 540	0.048	0 162	0 144	0.153	0 730
15					1.000	-0.279	0 101	-0.215	-0 005	-0.578
16						1.000	0.020	0 077	0.003	0 418
17							1.000	0 056	0.030	0 170
18								1.000	0.178	-0.016
19									1.000	-0.007
20										1.000

TABLE 3

ILLUSTRATION OF COMPUTER OUTPUT
WHEN USING MULTIPLE CORRELATION PROGRAM
ELASTICITY B_5 REGRESSED AGAINST 1960 SOCIOECONOMIC VARIABLES
STEP 1 OF MULTIPLE CORRELATION

SUB PROGRAM 2

DEPENDENT VARIABLE	19
MAXIMUM NUMBER OF STEPS	40
F LEVEL FOR INCLUSION	0.001000
F-LEVEL FOR DELETION	0.000010
TOLERANCE LEVEL	0.001000

STEP NUMBER 1
VARIABLE ENTERED 11

MULTIPLE R	0.3300
ETO EAB OF EST	0.7524

ANAEYSIE OF VARIANCE

	DF	SUM OF SQUARE	MEAN SQUARE	F RATIO
REGREEEION	1	8.304	8.304	14.886
REEIDUAL	120	67.932	0.566	

VARIABLES IN EQUATION				VARIABLES NOT IN EQUATION			
VARIABLE	COEFFICIENT	ETD ERROR	F TO REMOVE	VARIABLE	PARTIAL CORR	TOLERANCE	F TO ENTER
(CONSTANT	-0.56502)						
11	0.03467	0.00905	14.4686	1	-0.13285	0.9685	2.1378
				2	-0.01564	0.9783	0.0231
				3	-0.09814	0.7110	0.9747
				4	0.16908	0.9570	0.4665
				5	-0.00843	0.8014	0.0085
				6	-0.13233	0.9504	2.0467
				7	-0.08507	0.7457	0.5155
				8	-0.11118	0.8501	1.4894
				9	0.11475	0.7972	1.5877
				10	-0.04407	0.8258	0.4035
				12	0.28572	0.8861	5.2580
				13	-0.11354	0.8717	1.7250
				14	-0.01154	0.7583	0.0158
				15	0.04611	0.9791	0.2535
				16	0.01169	0.9293	0.0162
				17	-0.01588	0.9613	0.0300
				18	0.15424	0.9837	2.3001
				20	-0.13587	0.8803	2.2652

TABLE 4

ILLUSTRATION OF COMPUTER OUTPUT
WHEN USING MULTIPLE CORRELATION PROGRAM
ELASTICITY o_5 REGRESSED AGAINST 1960 SOCIOECONOMIC VARIABLES
STEP 2 OF MULTIPLE CORRELATION

STEP NUMBER 2
VARIABLE ENTERED 12

MULTIPLE R 0.3829
STD. ERROR OF EST 0.7394

ANALYSIS OF VARIANCE

	DF	SUM OF SQUARES	MEAN SQUARE	F RATIO
REGRESSION	2	11.179	5.589	10.224
RESIDUAL	119	65.057	0.547	

VARIABLES IN EQUATION				VARIABLES NOT IN EQUATION			
VARIABLE	COEFFICIENT	STD. ERROR	F TO REMOVE	VARIABLE	PARTIAL CORR.	TOLERANCE	F TO ENTER
(CONSTANT	-0.10405)						
11	0.02735	0.00945	8.3796	1	-0.17969	0.9248	3.9371
12	0.01253	0.00546	5.2589	2	-0.00017	0.9727	0.0000
				3	-0.10739	0.7074	1.3767
				4	0.03587	0.9474	0.1520
				5	0.04990	0.7018	0.5795
				6	-0.11516	0.6562	1.5859
				7	-0.07320	0.7413	0.7449
				8	-0.01568	0.6585	0.0280
				9	0.12387	0.7864	1.8389
				10	-0.00435	0.7556	0.0022
				13	-0.07237	0.8183	0.6212
				14	-0.08711	0.6735	0.9022
				15	0.05171	0.9786	0.3163
				16	0.03239	0.9300	0.1239
				17	-0.00838	0.9800	0.0083
				18	0.21364	0.9335	5.6436
				20	-0.16392	0.8639	3.5085

TABLE 5

ILLUSTRATION OF COMPUTER OUTPUT
WHEN USING MULTIPLE CORRELATION PROGRAM
ELASTICITY o_5 REGRESSED AGAINST 1960 SOCIOECONOMIC VARIABLES
STEP 3 OF MULTIPLE CORRELATION

STEP NUMBER 3
VARIABLE ENTERED 18

MULTIPLE R 0.4308
STD. ERROR OF EST. 0.7254

ANALYSIS OF VARIANCE

	DF	SUM OF SQUARES	MEAN SQUARE	F RATIO
REGRESSION	3	14.148	4.716	8.963
RESIDUAL	118	62.087	0.526	

VARIABLES IN EQUATION

VARIABLE	COEFFICIENT	STD. ERROR	F TO REMOVE
(CONSTANT	-0.14608)		
11	0.02336	0.00942	6.1498
12	0.01564	0.00552	8.0361
18	0.00296	0.00125	5.6436

VARIABLES NOT IN EQUATION

VARIABLE	PARTIAL CORR.	TOLERANCE	F TO ENTER
1	-0.18242	0.9247	4.0273
2	-0.01912	0.9655	0.0428
3	-0.13533	0.6585	2.1828
4	0.04868	0.9446	0.2779
5	0.04229	0.6883	0.2096
6	-0.06438	0.5202	0.4870
7	-0.13780	0.6983	2.2648
8	0.01649	0.6441	0.0318
9	0.09250	0.7759	1.0186
10	-0.12700	0.5765	1.9179
13	-0.07072	0.8181	0.5881
14	-0.13711	0.6450	2.2416
15	0.10232	0.9334	1.2378
16	0.02026	0.9866	0.0480
17	-0.01633	0.9787	0.0312
20	-0.16887	0.8634	3.4343

TABLE 6

ILLUSTRATION OF COMPUTER OUTPUT
WHEN USING MULTIPLE CORRELATION PROGRAM
ELASTICITY O_5 REGRESSED AGAINST 1950 SOCIOECONOMIC VARIABLES
STEP 4 OF MULTIPLE CORRELATION

STEP NUMBER 4
VARIABLE ENTERED 7

MULTIPLE R 0.4484
STD. ERROR OF EST 0.7215

ANALYSIS OF VARIANCE

	DF	SUM OF SQUARES	MEAN SQUARE	F RATIO
REGRESSION	4	15.327	3.832	7.361
RESIDUAL	117	60.906	0.521	

VARIABLES IN EQUATION				VARIABLES NOT IN EQUATION				
VARIABLE	COEFFICIENT	STD. ERROR	F TO REMOVE		VARIABLE	PARTIAL CORR.	TOLERANCE	F TO ENTER
(CONSTANT	-0.18071)							
7	-0.02329	0.01548	2.2648	.	1	-0.12604	0.5951	1.8725
11	0.03038	0.01047	8.4242	.	2	0.01014	0.3229	0.0119
12	0.01660	0.00553	9.0263		3	-0.03859	0.2224	0.1730
18	0.00342	0.00128	7.1848	.	4	0.03639	0.9364	0.1538
				.	5	-0.04949	0.4464	0.2648
					6	-0.08785	0.5075	0.9022
					8	-0.07180	0.4489	0.6011
					9	0.12842	0.7366	1.9453
					10	-0.04631	0.3127	0.2494
				.	13	0.01967	0.4599	0.0449
					14	-0.03714	0.1705	0.1602
					15	0.04229	0.7228	0.2078
				.	16	0.03473	0.9764	0.1401
				.	17	0.01309	0.9354	0.0199
				.	20	-0.10057	0.3953	1.1852
				.				

TABLE 7

ILLUSTRATION OF COMPUTER OUTPUT
WHEN USING MULTIPLE CORRELATION PROGRAM
ELASTICITY D_5 REGRESSED AGAINST 1960 SOCIOECONOMIC VARIABLES

STEP NUMBER	VARIABLE ENTERED	VARIABLE REMOVED	MULTIPLE R	MULTIPLE RSQ	INCREASE IN RSQ	F VALUE TO ENTER OR REMOVE	NUMBER OF INDEPENDENT VARIABLES INCLUDED
1	11		0.3300	0.1089	0.1089	14.6684	1
2	12		0.3829	0.1466	0.0377	5.2589	2
3	18		0.4308	0.1856	0.0390	5.5436	3
4	7		0.4484	0.2011	0.0155	2.2548	4
5	9		0.4628	0.2142	0.0132	1.9453	5
6	5		0.4693	0.2203	0.0060	0.8920	6
7	6		0.4768	0.2273	0.0071	1.0437	7
8	15		0.4834	0.2336	0.0063	0.9274	8
9	8		0.4904	0.2405	0.0069	1.0179	9
10	10		0.4953	0.2453	0.0048	0.7045	10
11	14		0.4988	0.2488	0.0034	0.5031	11
12	16		0.5002	0.2502	0.0015	0.2118	12
13	17		0.5012	0.2512	0.0010	0.1472	13
14	2		0.5019	0.2519	0.0007	0.0932	14
15	3		0.5022	0.2522	0.0003	0.0368	15
16	4		0.5023	0.2523	0.0001	0.0135	16
17	13		0.5023	0.2523	0.0000	0.0018	17

were retained in the memory of the computer and used for calculating partial correlations of each independent variable not yet brought into the multiple correlation equation. This provided a measure which enabled the machine to select the appropriate independent variable to next bring into the computation. The simple correlations, used together with the means listed on the first page of the illustration, were again used after completion of the machine computation of multiple correlation, in order to refine the significant multiple regression equation. This refinement is described in the next section of this chapter.

Tables 3 thru 6 of the computer output illustration portray the first four steps in the multiple correlation computation. The reader will notice that the illustration covers the second sub-problem of the combined computation. The three sub-problems were similar, nothing would be gained by showing all three. Sub-problem number two, elasticity D_5 regressed against socioeconomic variables for calendar year 1950, was chosen simply because fewer steps were required to reach the significant regression equation, using the significance test described above.

Step one (Table 3) identified the dependent variable as number 19, and stated the F level required for inclusion (0.001), the F level at or below which an included variable will be rejected (0.00001), and the tolerance level (0.001). It then continued with the computation, printing as output the information listed above under the section "Multiple regression technique." Independent variable number 11 was brought into the regression equation in this step. Its partial correlation with the

dependent variable was not printed, but it was computed by the machine and compared to the partial correlations for all other independent variables. In order for variable 11 to be selected for inclusion, it had to have the highest partial correlation of all the outstanding independent variables, as well as having an F level as high as .001.

Of the remaining independent variables, number 12 had the highest partial correlation with the dependent variable, a value of .20572, and it was the variable selected for inclusion in step two. The reader should be aware that although variables 1 and 20 are shown among the variables not in the equation, the machine program excluded them from consideration, since they were the dependent variables used in sub-problems one and three. Actually, no purpose was accomplished by including them in the printed output of sub-problem two. They were allowed to print only because of the difficulty of programming their elimination from the printout of the sub-problems to which they did not apply, and because some uses of the computer program find an advantage in having them included.

The reader should be cautioned that the numbers identifying the variables in the machine output are not the same as the identification symbols used in this report of the study. The computer program automatically numbers the variables in the order that they appear in the punched cards used for machine input, whereas it was deemed advisable to symbolize the variables for report purposes consistent with the symbols used in the related previous studies. The respective equivalents are indicated in the tabulation on the following page.

TABLE 8

CORRESPONDENCE BETWEEN COMPUTER IDENTIFICATION NUMBERS AND VARIANCE SYMBOLS

Identification Number in Computer Output	Symbol used in Report	Identification Number in Computer Output	Symbol used in Report
1	E_5 or E_7	11	X_{14}
2	X_1	12	X_{15}
3	X_2	13	X_{16}
4	X_3	14	X_{17}
5	X_5	15	X_{18}
6	X_6	16	X_{19}
7	X_7	17	X_{21}
8	X_8	18	X_{22}
9	X_{12}	19	D_3 or D_5
10	X_{13}	20	R_4

The third step brought variable 18 into the computation, the fourth step, variable 7. The computation continued in this manner until all independent variables were tested for entry and all variables entered were tested for rejection. In the particular sub-problem chosen for illustration, all 17 of the independent variables were eventually chosen for inclusion, and none was rejected after being entered. However, only four steps are shown, since this number of steps suffices for the purpose of demonstrating the application of the t-test for significance, as follows.

In step one, the regression coefficient of 0.03467 is more than 1.98 times its standard error of 0.00305, and as such it is considered significant, and the test proceeds to the next step. The coefficients in step two, 0.02735 and 0.01253, exceed their respective standard errors, 0.00945 and 0.00546, by more than a multiple of 1.98, so this step was also accepted. Similarly, the coefficients in step three all passed the t-test thus applied, but in step four, variable seven, which was being entered, failed to equal 1.98 times its standard error (0.02329 compared to 0.01548), and therefore the entire step was rejected. The previous step, step three, was thus accepted as final, with only the variables accepted at that point being considered significant. Furthermore, the regression equation set forth by that step was considered the most significant equation for predicting the dependent variable.

Table 7 of the illustration displays a summary of the entry and removal of variables throughout all the different steps of the computation, and it shows the value of both multiple correlation and variance at the completion of each step, together with the change in variance caused by each entry and each removal. This table is very relevant to the first three hypotheses of this study inasmuch as it indicates the contribution of each variable to the overall variance.

Up to this point, the multiple regression techniques employed in this study are similar to those used in the separate studies of Florida, Georgia, Kentucky, and Illinois. The computer program has been redesigned to reflect more information in a more usable format, but the statistical result is identical. And the significance tests employed here are the same as the ones used previously, such that any given set of data would product identical regression equations and related constants.

Therefore, the results, up to this point, are comparable, and they have been compared in the analyses of data to the extent such comparison was deemed relevant to the current study.

However, it was felt that a refinement was needed to the above procedure before the coefficients of the regression equation would indicate with the desired degree of specificity the relationship of each included independent variable to the related dependent variable. Therefore, the current study needed a rather extensive modification to the statistical procedures used in the previous studies, in order to transform the regression equations into more meaningful form. The need for this modification and its application are described in the following section.

Removal of Interdependency between Independent Variables

Cells (1967) cautions that the theory of regression requires all observations of each independent variable to be completely free of any interrelationships with other independent variables. He points out that violations of this principle can result in overstatement of regression relationships, and he makes the following statement regarding computation of regression equations by usual methods (which would include the methods used in this study):

> When model building is completed, the multiple correlation between the dependent variable and the independent variable will be high and the variance will be small so the model will be suitable for predicting purposes. However, it will be of little value for other analysis purposes because the parameters will be so obviously unrealistic.

Since the primary purpose of deriving regression equations in this study is not for prediction purposes, but rather for illustrating relationships between variables, it is obvious that some adjustment in the

parameters produced by the above multiple regression procedures was needed. That is not to say that these procedures should not have been used, for quantification of the components of the regression model must begin with the calculation of the parameters of the functional relationships between the independent variable and the data of each independent variable. Cella (1967) refers to these as "gross" regressions because "part of the changes in the values of the dependent variable are due to changes in the values of one independent variable and the remainder are due to changes in other independent variables." Under these circumstances, the measurement of the regression relationship is the largest possible, because all the changes in the dependent variable have been attributed to one variable. Yet variations in the dependent variable are almost invariably caused by changes in several independent variables acting simultaneously--thus, the term "multiple regression."

The following explanation by Cella (1967) tells why it is so essential to transform these gross regressions to net regressions, thus eliminating the effect of interdependency between independent variables:

> In a multiple regression, the relationship between each independent variable and the dependent variable is a net rather than a gross. The net regression measures the variation of the dependent variable which is caused by variations in an independent variable, with the impact of the other independent variables measured also. Each of these latter is measured as though all of its values were identical so instead of multiplying a regression coefficient by a variable, the same amount is deducted from the dependent variable for each observation. As a result, the net regression describes the variation in the dependent variable which is due to changes in a particular independent variable. Since the net regression only explains the variation in the dependent variables which is due to a particular independent variable, it will be less than the gross regression. In a demand analysis a gross regression merely measures the amount of associated variation between the variable while a net regression attempts to measure the amount of cause and effect.

These remarks imply that the parameters of the net regression equation indicate the relationship of each independent variable to the dependent variable more accurately than do the parameters of the unrefined regression equation. Since accuracy with regard to this relationship lies at the heart of the present study, it was felt to be essential that the gross regression coefficients be converted to net coefficients. As explained in the M.I.T. Summer Course on Operations Research (1953), this requires the calculation of a system of weights which indicate the relative importance of the independent variables. The effect of this weighting is to appreciably scale down the size of coefficients which have minor influence upon the dependent variable and to make lesser reductions in coefficients having more significant effect upon the dependent variable. Different methods for applying weightings are proposed by Frisch (1934), Wold (1953), Ferber (1962), and others. These methods for quantifying the model are not the same as the conventional least squares analysis approach, although the objectives are similar. Furthermore, the models which have been transformed by weighting are suitable for a variety of applications rather than being restricted to prediction purposes.

The weighting system is actually a second weighting, inasmuch as the gross regression coefficients themselves are weights, functioning as multipliers of the independent variables. Cella (1967) therefore describes the weighting system of a transformed regression equation by a formula similar to that shown below, and he illustrates the effect of the transformation as shown in Figure 1 on the following page.

$$Y = b'_0 + w_1 b_1 X_1 + w_2 b_2 X_2 + \ldots$$

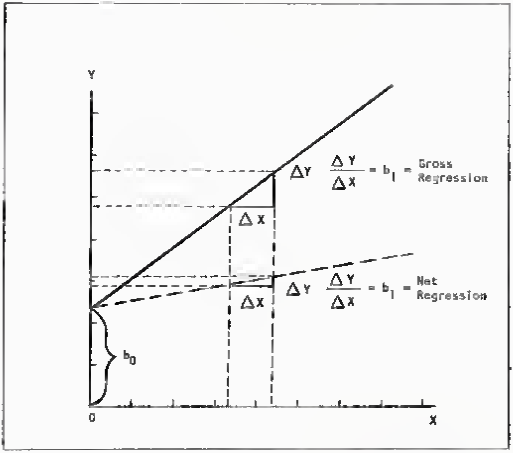

Figure 1: Gross Regression Versus Net Regression*

*Source: Cella (1967)

where b_1, b_2, etc., are gross regression weights and w_1, w_2, etc., are the importance weights for converting to net regression

Importance weights used in this study for converting from gross to net regression consist of coefficients of partial correlation between the individual significant independent variables and the concerned dependent variables. In suggesting this use of partial correlations, Cella (1967) advises the reader as follows:

> A partial correlation is a measure of the extent to which the variation in the dependent variable is explained by an independent variable. When all the factors which influence a dependent variable are included in an analysis, the partial correlation coefficients will measure the extent to which each independent variable affects the dependent variable.

Croxton and Cowden (1955) describe coefficients of partial correlation as measures of "the relative importance of the different independent variables in a problem in explaining variations in the dependent variable." Inasmuch as the present study is highly concerned with discovering the relative importance of the different independent variables in molding school fiscal policy, it makes extensive use of partial correlations as a weighting system for refining the gross regression equations.

However, Cella (1967) cautions, "The calculation of importance weights is a drawn-out task, even with the aid of a computer." It requires first the computations of zero-order correlations for each possible pairing of variables from the gross regression equation. The zero-order correlations are used in turn to compute a series of first order correlations, using the general formula

$$r_{12.3} = \frac{r_{12} - r_{13}\, r_{23}}{\sqrt{(1 - r_{13}^2)(1 - r_{23}^2)}}$$

where one is the dependent variable, two is the first independent variable being correlated with the dependent variable, and three is the particular independent variable being held constant. The subscripts are changed to fit the numbers of the variables involved in the computation. The "order" of a partial correlation refers to the number of variables being held constant, and the symbol for partial correlation indicates this by the number of subscripts following the decimal. Thus, the above formula provides for the computation of first order correlations.

Each partial correlation used as an importance weight for transforming a gross regression to net must hold constant all but one of the independent variables. The order of the partial correlation required is therefore one less than the number of independent variables. Since some of the regression equations found to be significant in this study contained as many as seven independent variables, it was necessary to compute partials as high as the sixth order, requiring the use of the following formulas in addition to the one shown above:

second order $$r_{12.34} = \frac{r_{12.3} - r_{14.3}\, r_{24.3}}{\sqrt{(1 - r_{14.3}^2)(1 - r_{24.3}^2)}}$$

third order $$r_{12.345} = \frac{r_{12.34} - r_{15.34}\, r_{25.34}}{\sqrt{(1 - r_{15.34}^2)(1 - r_{25.34}^2)}}$$

fourth order $$r_{12.3456} = \frac{r_{12.345} - r_{16.345}\, r_{26.345}}{\sqrt{(1 - r^2_{16.345})(1 - r^2_{26.345})}}$$

fifth order $$r_{12.34567} = \frac{r_{12.3456} - r_{17.3456}\, r_{27.3456}}{\sqrt{(1 - r^2_{17.3456})(1 - r^2_{27.3456})}}$$

sixth order $$r_{12.34567} = \frac{r_{12.34567} - r_{18.34567}\, r_{28.34567}}{\sqrt{(1 - r^2_{18.34567})(1 - r^2_{28.34567})}}$$

The first order partials are used to calculate the second order, the second to compute the third, etc. It becomes apparent that a tremendous number of computations are required in order to obtain the needed importance weights when the number of independent variables reaches four or more. This might well have been an influential factor retarding the application of weightings to multiple regression equations in prior research.

To illustrate the use of partial correlations as weighting factors for converting gross multiple correlations to net, the significant equation for P_5, based upon raw data, is used.

Gross Regression Equation $$P_5 = -.14608 + .02366\, X_{10} + .01564\, X_{11} + .00296\, X_{17}$$

Partial coefficients and their conversion to importance weights

Partial Coefficient		Importance Weight
β_5 to X_{10}	= .2229	$w_1 = \frac{.2229}{.6885} = .3237$
β_5 to X_{11}	= .2523	$w_2 = \frac{.2523}{.6885} = .3664$
β_5 to X_{17}	= .2133	$w_3 = \frac{.2133}{.6885} = .3099$
Total	.6885	

In converting partial coefficients to importance weights, all values are treated as positive, regardless of their actual sign. But when the weights are multiplied by gross coefficients to produce net coefficients, the signs of the coefficients are retained. This transformation appears as follows:

Gross Regression	Importance Weight	Net Regression
$b_{10} = +.02366$	.3237	.00756
$b_{11} = +.01564$	.2664	.00573
$b_{17} = +.00296$	.3099	.00092

The constant term must also be transformed, using the following formula:

$$b_0' = \bar{Y} - b_1' \bar{X}_1 - b_2' \bar{X}_2 - b_3' \bar{X}_3 - b_3' \bar{X}_3^2$$

where b_0' is the constant term of the net equation, $\bar{Y}$, the mean of the dependent variable, the b' terms, the net regression coefficients computed above, and the $\bar{X}$ terms, the means of the respective independent variables. The last term of the formula illustrates the fact that the

net regression coefficient would be calculated for higher powers of a variable in exactly the same way as for linear terms. Using the above formula, the constant term for the O_5 raw data net regression would be calculated as follows.

(1) Gross Constant Term	(2) Net Regression Coefficient	(3) Means of Independent Variables	(4) Product of (2) x (3)	(5) Difference in Totals (1) less (4)
b_0 = 1.12090				
	b_{10} = .00756	34.25835	.25935	
	b_{11} = .00573	22.88852	.13116	
	b_{17} = .00092	36.37048	.03352	
1.12090		-	.42403	= .69687 = b_0'

This completes the transformation of parameters. Substituting the computed estimates of net regression for the gross parameters, the equation yields the following net regression model:

$$O_5 = .69867 + .00756\ X_{10} + .00573\ X_{11} + .00092\ X_{17}$$

This equation gives the relationships of the respective significant independent variables to the dependent variable, with the interdependent effects of other independent variables eliminated. Thus it can be used to more realistically analyze the relationships of socioeconomic factors to school fiscal policy. Therefore, the net regression has been derived in this study for each of the dimensions of local school fiscal policy: financial effort, elasticity of demand for education, and revenue receipts per pupil. This, together with the gross multiple correlation and its related constants have been used to investigate the last three hypotheses.

The use of weighting systems to convert gross regression models to net is not a new or exclusive statistical technique. It was a central topic at the MIT Summer Course on Operations Research (1953), and it has been discussed in statistical texts including those by Frisch (1934), Wold (1953), Ferber (1962), and Croxton and Cowden (1955). However, it was felt to be advisable to make a sample test of the regression models which were thus transformed in the present study. The test was conducted as follows, for each regression equation tested.

The gross equation was used to predict the value of the dependent variable for each of the 122 districts in the sample. Next the corresponding net equation was used to calculate its prediction of the same dependent variable for each of the districts. Then each set of predictions was correlated against the actual values of the dependent variable in order to ascertain that there was no material loss of predictive accuracy resulting from the transformation. The results of these tests are discussed in the next chapter.

Alternative significance test

In the procedures described above, this study has followed the identical significance test as was used in the original studies. This has allowed the results of the current study to be compared to those of the original, but this researcher feels that the application of a t-test is in effect the rendering of a second significance test. The use of F levels as criteria for entry and removal of independent variables during the multiple regression computation serves as a basic significance test. By regulation of the F levels specified for inclusion, the degree of relationship of selected variables could be controlled, eliminating the need for a second significance procedure.

Futhermore, it is felt thet the elimination of variables through this particular application of the t-test at a level as high as 0.05 is undesirable because of the extensive impact it has upon total variance. This is illustrated in Table 7, which summarizes the results of elasticity of demand E_S being regressed in multiple step wise regression against the 17 selected socioeconomic variables. Only three variables are accepted by the t-test as being significant, whereas all 17 of the independent variables are brought into the regression equation by the multiple correlation program. The variance associated with the three variables is only 0.1856 as compared to 0.2523 for all seventeen. Although it is convenient to reduce the number of variables by the application of a significance test beyond that of the F levels used in the multiple regression program, the accuracy of the computation appears to be much greater with the retention of a larger number of variables. The progressive effect of the eliminations is shown by the "INCREASE IN RSQ (R squared, or variance)" column of Table 7. The first variable eliminated by the t-test would have contributed more than 8 per cent as much variance than the total variance accepted as being significant. The total variance eliminated by the t-test would have contributed more than 35 per cent as much as the recognized variance.

Therefore, as an additional procedure, the 1960 regression equations for financial effort, elasticity of demand, and revenue receipts per pupil were recomputed without the benefit of the t-test. In each case, the gross equation was determined and then transformed to net. This was followed by calculating partial correlations between the independent variables with the respective dependent variables, coefficients of partial determination, importance weights, contributions toward total

variance, total multiple correlation, and total variance. The significance of each of these is discussed in Chapter III, and the computed values are tabulated for easy reference. The computations were made both using raw data and using standardized deviate value equivalents.

CHAPTER III

ANALYSES AND INTERPRETATIONS OF DATA

All of the 122 districts provide local support of public education through property taxes. As pointed out in Chapter I, the quality of the instructional program is strongly related to the financial support provided. For this reason, educators are vitally concerned with maintaining a school fiscal policy that is conducive to adequate financial support. The purpose of this chapter is to examine the relationship of the 17 selected socioeconomic variables to local school fiscal policy, so as to determine whether they might serve as a leverage toward better support.

To relate fiscal policy statistically, it was necessary to quantify each of the study variables. Three measures of fiscal policy were used in the original studies of Florida, Georgia, Kentucky, and Illinois: financial effort, elasticity of demand for education, and revenue receipts per pupil. Each of these is defined in Chapter I under "Definition of terms," and discussed in Chapter II under "Sources of data." The most traditional measure is revenue receipts per pupil, for which fiscal policy is quantified by dividing total revenue receipts by total pupils in average daily attendance. However, there is an inherent limitation in this measure of fiscal policy. It corresponds too closely with the amount of financial resources available--the ability to support education. Those districts which have higher per capita personal income tend to pay more for education. A measure of fiscal policy which would

be more meaningful to educators would be an index of the effort made by the district to use its resources for education, regardless of the level of resources available. As such, a second measure of fiscal policy has been used, one which tends to eliminate the effect of adequacy of financial resources. It relates financial support actually provided for education to the total available resources. Total local school revenue is divided by total disposable personal income for the district, reflecting a measure which is defined in this study as financial effort. This may be considered as an index of the district's willingness to use its resources for education.

Another measure of fiscal policy, which has proven to be quite useful is the elasticity of demand for education. It indicates the response of a school district to a change in per capita disposable income. The greater the portion of an income increment invested in education, the greater the elasticity of demand. Basically, the coefficient of elasticity indicates what percentage change in revenue per pupil accompanies each percentage change in per capita net effective buying income.

If the ratio of pupils to total population remains unchanged, then the coefficient of elasticity of demand indicates the tendency of financial effort to change, since the basic formula would be reduced to percentage change in revenue divided by percentage change in net effective buying income. For this reason, elasticity of demand is sometimes seen as a modification of "financial effort," denoting the extent of inclination for effort to change directly with change in personal income. A difficulty is presented with using the basic formula when there exists a change in revenue but none in personal income, for the computation would give infinity as an answer. For this reason a more sophisticated

formula is provided, as described under "Source of data," Chapter II, which gives essentially the same result while overcoming this difficulty.

The first step in analyzing the data relating to the above three measures of fiscal policy was to examine the patterns of financial effort and elasticity of demand to determine their consistency among the respective districts over a period of time.

Consistancy of Effort and Elasticity

As might be suspected, there was considerable variation in financial effort among districts. The highest among the 122 districts had an effort more than fifteen times as high as that of the lowest. This is shown by Table 9, which, in addition to ranking the districts by level of financial effort (E_7) shows the specific effort rating of each district and the change in ranking during the previous ten years. The ranking change was computed by comparing E_7 and E_5 rankings. A summary of these changes show that out of 122 ranks, a majority of 69 districts experienced ranking changes of less than 15 places. Furthermore, 105 of the districts changed less than 30 places, indicating high stability of effort. High effort districts tended to remain high, and low effort districts tended to remain low. A few districts made marked changes in relative position over the ten year time span. Eight districts changed in rank by more than forty places. Table 9 identifies these districts only by code number, so it was necessary to refer to Appendix B in order to find the names of these districts, which are as follows:

State	District	Ranking Change
Florida	Orange	-55
Florida	Leon	-70

Georgia	Clayton	-74
Kentucky	Carter	-47
Kentucky	Knox	-43
Kentucky	Pike	-54
Illinois	Jacksonville	+45

A quick review of Table 9 shows that the four states tend to stratify, with Illinois tending to fill the upper ranks, Georgia the lower, and Florida and Kentucky respectively filling the intermediate ranks. The average ranks and mean financial effort ratings by state are shown below, and they further substantiate the stratification mentioned above:

State	Average Rank	Mean E_7 Effort	Mean E_5 Effort
Illinois	15.2	3.422	2.0864
Florida	59.4	1.573	1.3947
Kentucky	70.4	1.3935	1.3626
Georgia	92.5	0.9400	0.8167

For each of the four states, the mean E_7 effort was higher than the mean E_5 effort. Similarly, the mean effort of the four-state composite increased from 1.39060 to 1.7835 during the same period. These points indicate that there was a general tendency for the level of effort to increase over the ten-year time span.

In summary, the analysis of rankings by financial effort tends to confirm the first hypothesis, which is restated as follows: "Most school districts follow consistent patterns of financial effort and elasticity, yet some make marked changes in relatively short periods of

TABLE 9

RANKINGS OF 1960 FINANCIAL EFFORT (E_7) AND CHANGES IN RANK SINCE 1956

Dist.	E_7	Rank	Δ	Dist.	E_7	Rank	Δ	Dist.	E_7	Rank	Δ	Dist.	E_7	Rank	Δ	Dist.	E_7	Rank	Δ
410	5.226	1	+ 8	308	2.573	26	+32	201	1.622	51	+40	226	1.284	76	0	208	0.856	101	+ 8
404	4.447	2	- 1	405	2.372	27	- 3	123	1.606	32	-36	319	1.243	77	+10	307	0.849	102	-84
403	4.430	3	0	423	2.366	28	+31	326	1.598	33	+37	120	1.227	78	+10	326	0.837	103	10
409	4.128	4	- 9	184	2.440	29	+27	325	1.591	54	+11	207	1.183	79	+40	213	0.843	104	+ 4
418	4.118	3	+13	425	2.437	30	+15	313	1.581	33	0	213	1.182	80	+30	313	0.782	103	-21
413	3.943	6	+ 6	104	2.222	31	-21	118	1.566	56	- 0	227	1.178	81	- 8	113	0.784	106	- 2
407	3.853	7	+ 7	310	2.186	32	+20	116	1.558	57	-30	213	1.156	82	+38	214	0.732	107	+ 8
413	3.843	8	+45	115	2.143	33	- 7	103	1.554	58	+16	107	1.138	83	+14	228	0.716	108	- 6
410	3.778	9	- 4	110	2.091	34	-30	132	1.524	59	-21	116	1.130	84	+17	212	0.700	109	+ 3
402	3.706	10	+22	126	2.036	35	+14	101	1.503	60	+23	109	1.124	83	+13	204	0.681	110	3
414	3.660	11	+ 8	108	2.011	36	- 7	311	1.491	31	+14	229	1.127	86	- 1	234	0.672	111	-22
403	3.640	12	+ 8	117	2.007	37	+ 4	327	1.483	62	-54	322	1.110	87	+24	231	0.333	112	+ 1
411	3.833	13	- 6	114	1.987	38	+16	121	1.474	33	-42	328	1.097	88	-27	203	0.330	113	+ 8
411	3.643	14	- 8	125	1.947	38	0	318	1.453	64	+ 8	219	1.091	89	+28	321	0.324	114	-43
417	3.317	13	+ 2	112	1.941	40	+ 7	304	1.436	65	+13	222	1.067	90	-28	205	0.683	113	+ 7
416	3.430	16	+ 7	407	1.825	41	+ 9	312	1.426	66	-26	217	1.030	91	+ 3	306	0.619	116	-70
428	3.234	17	-15	220	1.818	42	+25	309	1.423	37	+14	225	1.016	92	+11	201	0.611	117	- 3
424	3.058	18	+15	123	1.801	43	+14	131	1.398	38	-25	128	1.006	93	29	233	0.547	118	- 2
401	3.039	19	+12	122	1.789	44	0	320	1.386	69	+21	329	0.986	94	-17	235	0.436	119	-40
413	3.012	20	- 9	302	1.769	45	+27	111	1.383	70	+10	102	0.978	95	- 8	314	0.374	120	-22
422	2.970	21	+21	301	1.764	46	-31	218	1.369	71	+35	208	0.977	96	+ 3	120	0.346	121	-33
406	2.785	22	+15	105	1.762	47	+15	209	1.338	72	+28	210	0.952	97	+17	206	0.330	122	-25
420	2.756	23	+11	313	1.718	48	-30	303	1.320	73	+22	224	0.906	98	+10				
317	0.701	24	+ 6	323	1.702	49	-13	127	1.293	74	+32	210	0.893	99	-24				
405	2.639	25	+10	124	1.663	50	+18	305	1.286	78	-47	223	0.879	100	+11				

time.[9] The analysis reflected the fact that most districts did experience relative consistency in effort pattern, with an overall trend to increase gradually. Yet, as hypothesized, a few districts made marked changes in pattern. Eight districts changed their relative ranks by more than forty places, which is over a third of the full range of rankings.

A similar analysis of rankings by elasticity of demand gave very different results. Table 10 presents the elasticity values (0_5), rankings, and changes in rank. Only 52 of the 122 districts changed position by as few as 30 places. Forty of the districts changed by more than 50 per cent of the full range of rankings, and six changed by more than 100 places. The inconsistency is further highlighted by the summary of means by state, which shows two states increasing while the other two are decreasing.

State	Average Rank	Mean 0_5 Elasticity	Mean 0_3 Elasticity
Georgia	41.1	1.7169	0.6552
Florida	54.0	1.2333	0.6872
Illinois	63.2	1.0109	1.1119
Kentucky	82.4	0.6078	0.7656

The composite mean increased from 0.73836 to 1.12090. Not only was there a general reshuffling of district rankings over the ten-year period, but the states tended to reverse their relative rank positions. The mean elasticity of two states increased sharply while the coefficients of the other two states were lowered. There was a general lack of consistency, which contradicts the first hypothesis with respect to elasticity.

TABLE 10

RANKINGS OF 1960 ELASTICITIES OF DEMAND (η_d) AND CHANGES IN RANK SINCE 1950

Dist.	η_d	Rank	Δ	Dist.	η_d	Rank	Δ	Dist.	η_d	Rank	Δ	Dist.	η_d	Rank	Δ	Dist.	η_d	Rank	Δ
210	4.23	1	+104	409	1.78	66	+ 12	218	1.21	51	- 77	416	0.78	76	- 64	121	0.44	101	+ 14
227	3.36	2	+105	209	1.76	67	+ 36	410	1.17	52	+ 17	725	0.77	77	98	113	0.42	102	- 98
420	2.88	3	+ 24	422	1.68	68	- 5	711	1.17	53	+ 25	120	0.77	78	+ 35	428	0.38	103	+ 19
220	2.66	4	+ 64	119	1.62	69	+ 62	228	1.10	54	+ 18	721	0.76	79	46	710	0.37	104	- 63
210	2.41	5	+ 62	419	1.57	70	+ 71	403	1.17	55	- 57	426	0.72	80	+ 77	413	0.38	107	- 79
234	2.38	6	+ 34	722	1.58	71	+ 64	305	1.08	56	+ 20	111	0.71	81	+ 77	408	0.32	106	+ 17
130	2.34	7	+ 87	104	1.56	72	- 15	424	1.07	57	- 10	414	0.70	82	- 71	715	0.32	107	- 78
703	2.30	8	+103	127	1.50	73	+ 53	421	1.05	58	+ 8	329	0.68	83	- 71	711	0.34	108	+ 10
233	2.26	9	+ 98	208	1.55	74	30	425	1.05	59	- 14	408	0.67	84	- 26	727	0.34	109	- 44
228	2.24	10	+ 87	129	1.55	75	+ 73	110	1.03	60	+ 32	107	0.67	85	+ 17	717	0.27	110	- 15
219	2.10	11	+ 77	128	1.27	76	+ 70	309	1.02	61	- 8	405	0.67	86	- 54	101	0.24	111	+107
105	2.10	12	+ 17	124	1.47	77	- 6	307	1.02	62	- 7	720	0.67	87	- 79	201	0.22	112	- 70
117	2.11	13	+ 80	207	1.48	78	- 24	415	1.01	63	- 48	204	0.62	88	+ 17	315	0.17	113	- 23
117	2.10	14	+ 69	307	1.27	79	- 2	717	1.00	64	- 45	118	0.62	89	- 54	301	0.17	114	- 27
732	2.07	15	+ 85	407	1.27	80	- 35	304	0.97	65	- 1	130	0.61	90	+ 20	322	0.17	115	- 81
128	2.07	16	+103	208	1.98	81	+ 68	117	0.97	66	+ 19	101	0.58	91	-85	307	0.06	110	- 17
205	1.99	17	+ 42	407	1.36	82	- 22	217	0.95	67	- 5	412	0.58	92	- 70	777	0.21	117	- 79
108	1.98	18	+ 57	114	1.34	83	+ 53	214	0.92	68	- 17	324	0.56	93	- 87	726	-0.01	118	- 77
427	1.68	19	+ 57	730	1.27	84	- 75	107	0.87	69	+ 5	126	0.55	94	64	321	-0.14	119	- 62
221	1.87	20	+ 29	427	1.27	85	- 0	128	0.85	70	- 64	417	0.57	95	- 77	411	-0.14	120	- 91
127	1.87	21	+ 59	710	1.26	86	- 10	319	0.83	71	0	318	0.49	96	-95	314	-0.43	121	- 43
228	1.85	22	+ 86	717	1.24	87	+ 71	227	0.81	72	42	327	0.48	97	+ 0	305	-0.52	122	- 42
217	1.81	23	+ 61	121	1.24	88	+ 62	207	0.81	73	- 77	312	0.48	98	+ 18				
207	1.77	24	+ 65	125	1.77	89	+ 5	401	0.80	74	58	328	0.48	99	- 20				
114	1.71	25	- 18	404	1.77	90	+ 29	108	0.79	75	- 47	410	0.46	100	- 79				

Thus, while financial effort was rising rather uniformly for a large group of districts with very little shifting of relative positions within the group, the elasticity of demand fluctuated without any obvious pattern, causing a complete reordering of relative ranks. Brazer (1959-18) points out that "although these (elasticity of demand) coefficients are valid for only very small changes in the independent variable, they provide a simple measure of the 'sensitivity' of the dependent variable to changes in the independent variable." In the context of the present study, this would be a sensitivity of local revenue per pupil to net effective buying income per capita. This sensitivity can change markedly from one period of time to another without a material change in effort. This is illustrated by the following example, which used the basic formula for elasticity (percentage change in revenue per pupil related to percentage change in net effective buying income per capita) in order to simplify the example.

	First Period	Second Period	Third Period
a. Revenue	$ 1,000,000	$ 1,070,000	$ 1,135,000
b. Pupils	10,000	10,400	11,000
c. Revenue per pupil	$ 100 00	$ 102 89	$ 103.18
d. Percentage change from previous period		2 89	0.28
e. Net effective buying income	$100,000,000	$105,000,000	$112,000,000
f. Population	50,000	52,000	53,500
g. Net effective buying income per capita	$ 2,000 00	$ 2,019 20	$ 2,053.50
h. Percentage change from previous period		0 96	3 68
i. Effort (e ÷ e)	1.000	1.019	1.013
j. Elasticity (d ÷ h)		3 01	0 076

There is nothing extreme about the example shown on the previous page, yet the coefficient of elasticity of demand has fluctuated wildly while effort has remained substantially constant. Although the averaging of values over a nine year period has tended to stabilize the elasticities of the districts in the composite sample, the effect demonstrated above is still present. Even using nine year averages, many districts experienced drastic changes in elasticity coefficients while their levels of effort changed very little. This researcher questions whether elasticity of demand is not overly sensitive for the purpose of evaluating the influences of socioeconomic variables upon school fiscal policy. This will be examined further when investigating the results of stepwise multiple correlations relating elasticity of demand to the 17 selected socioeconomic variables.

Relationship of (a) Financial Effort to
(b) Fiscal Response to Income Change

It has been hypothesized that high effort districts are more responsive to change in per capita personal income than are low effort districts, such that a greater portion of increases in their personal income is invested in education. The validity of this hypothesis was investigated by correlating financial effort E_7, the average effort for years 1959 through 1961, against elasticity of demand for education b_5, the 1953 through 1962 average.

Pearson r was first calculated using raw data and found to have a value of 0.00516. This is obviously an extremely low correlation, but to further evaluate its significance, a t-test was applied, using the formula

$$t = \frac{r\sqrt{N-2}}{\sqrt{1-r^2}}$$

where r is the Pearson r discussed, and N is the number of pairs of observations in the sample. This computation reflected a value of 0.0565 for t, and it was used in a test for significance as described by Crowley and Cohen (1963). "The test of significance of a correlation is a test of the null hypothesis, 'the obtained correlation in this sample is not different from a correlation of zero.' Any difference can be ascribed easily to a chance variation about population correlation of zero."

If the calculated value of t exceeds the t-table value, significance is indicated, otherwise, the null hypothesis is confirmed. In the present case, the t-table value for 120 degrees of freedom at the 0.05 level is 1.98. The calculated value, being much smaller than this, confirms the null hypothesis and leads to the conclusion that any difference can be ascribed easily to chance variation.

But have we combined the variables from the four states on comparable bases? It has been pointed out in the previous section of this chapter that there is a consistent stratification of effort levels between the four states, and Chapter II explained that raw data permit extraneous factors to influence variables in some states while not affecting those in others. Legal restrictions upon levels of taxation and fiscal dependence, for example, are among the factors most commonly found to cause such stratification. The effects of such extraneous factors had to be removed if the correlations were to be meaningful. The method chosen for placing the values of effort and elasticity for the districts of the four respective states on a comparative basis was transformation from raw values to Z values using the simple formula

$$Z \text{ value} = \frac{X - M}{SD}$$

where X is the raw value of the variable being transformed, M is the mean of the sample variable, and SD is the standard deviation of its distribution. Transformations of variables from the four states were made separately and the resultant Z values provided bases sufficiently comparable to permit the data to be combined for composite analysis.

Drawbacks in the use of standardized data were recognized. While standardization eliminated deviations caused by extraneous effects, it was likely that some of the sought-for deviation would also be eliminated, that which was caused by the selected socioeconomic factors. Furthermore, it was necessary to proceed on the assumption that the forms of distribution for the different states were nearly identical, which is highly improbable. However, as Guilford (1965) points out, "In spite of these limitations, it is almost certain that derived scales, such as the standard-score scale, provide us with more nearly comparable values than do raw-score scales."

After converting both variables to standardized deviate value equivalents, the Pearson r was again calculated and found to have a higher correlation. The coefficient based on Z values was 0.2607. The t-test showed significance at the 0.01 level, with a t-value of 2.95. But even with the higher correlation using Z values instead of raw data, only 6.20 per cent of the total variance is accounted for. This degree of support for the second hypothesis is still very weak to be considered. This researcher has therefore reached the conclusion that there is little recognizable association between level of effort and fiscal response to change in personal income.

Relationship of Socioeconomic Factors to Local School Financial Effort

At this point it might be well to recall the statement of the central problem with which this study is concerned. In Chapter I it was brought out that recent research studies concerning influences upon school fiscal policy have identified two general categories of determinants: (a) socioeconomic--those which are inherent in the society, the culture, and the economic system of the district, and (b) leadership-related--those which are based upon leadership traits of influentials, decision making processes, value systems of the informal power structure, typology of the power structure, and leadership of the superintendent and other educational officials. If educational leaders are to be effective in shaping school fiscal policy, they must know which of the above categories of determinants are influential and to what degree, for the strategies which would be effective in bringing about desirable change would be exceedingly different under the two alternatives.

The primary purpose of the current study was to test a selected group of variables from the first category, socio-economic determinants, so as to investigate their effect upon school fiscal policy. If found to be influential, then educators must consider them in planning strategies for change, but if ineffective, they must look to other factors as possible determinants, such as the leadership-related determinants. Current research is being increasingly devoted to investigating the influence of the latter upon school fiscal policy. The results of that research should complement the findings of the current study in guiding educators to the most effective means of shaping school fiscal policy.

The investigation of possible relationships between socioeconomic variables and school fiscal policy was begun by using a step-wide multiple correlation technique relating the selected 17 socioeconomic variables to local school financial effort. Due to dependence of the investigator upon the federal census, socioeconomic data were available only for decennial years. As such, relationships between variables had to be examined on a cross-sectional basis (also called place-to-place or spatial) rather than a time (or sequential) basis.

All the first-order correlations generated by the computer program are presented in Appendix C. Their importance derives from the fact that they not only provide the basic values for determining the selection of variables for inclusion in the multiple correlation models, but they also provide the means of transforming gross regression equations to net. The use of first-order correlations in generating importance weights is discussed in Chapter II. By listing the correlation matrices in full in Appendix C, the writer avoided the necessity of repeatedly extracting partial listings for insertion at appropriate points in the text, as was done in the previous studies of the four states. The reader will notice that a single table presents all possible first-order correlations among the three dependent variables and 17 socioeconomic variables. However, separate tables are required for different time periods (1950 and 1960) and for different bases of data (all raw and all standardized Z values).

Relationship of 1950 socioeconomic factors to financial effort E_5

Two separate regressions were made relating the dependent factor of financial effort E_5, to the 17 selected socioeconomic independent variables. The first regression used raw data for all variables, the

second, Z values for all variables. The results of these regressions are summarized in Tables 11 and 12, respectively.

The first line of each table lists the constant term and all coefficients of the regression equation which were found to be significant by t-test (described in Chapter 11). These coefficients are labeled as "gross regression coefficients," following the terminology used by Cella (1967). The term "gross" implies that "part of the changes in the values of the dependent variable are due to changes in the values of one independent variable and the remainder are due to changes in other independent variables." Coefficients obtained by multiple correlation are therefore overstated because of the effect of interdependency between independent variables. A detailed explanation of this effect is given in Chapter 11, showing that such equations are suitable for predicting purposes but are of little value for other analysis purposes because the parameters are so unrealistic. The explanation presented there goes on to describe a method for transforming the gross regression equation to net, thereby providing coefficients which attempt to measure amount of cause and effect rather than mere association between variables. The second lines of the respective summaries of regression analysis present the coefficients and the constant term of the net regression equations.

Referring to Table 11, for example, there is a striking difference between the coefficients of the gross and the net regression equations. Each net coefficient is only a fraction of the respective gross coefficient, and the constant term of the net equation is positive compared to the negative constant term in the gross equation. Cella (1967) commented as follows regarding the effects that occur in building a gross model,

TABLE II

SUMMARY OF E_5 REGRESSION ANALYSIS
BASED UPON RAW DATA

	Variables					
	E_5	X_3	X_7	X_8	X_{19}	Constant
Gross Regression Coefficient		0.05699	0.16196	-0.01355	0.08361	-0.32493
Net Regression Coefficient		0.01814	0.03572	-0.00342	0.02234	0.89634
Mean	1.33060	16.39735	2.00410	16.23770	8.09098	
Standard Deviation	0.62929	4.08254	1.23606	14.42674	2.68395	
Simple Correlation with E_5		0.085	0.313	-0.401	0.420	
Partial Correlation with E_5		0.3779	0.3206	-0.3669	0.3884	
Coefficient of Partial Determination		0.1428	0.1028	0.1346	0.1509	
Importance Weight		0.25994	0.22053	0.25237	0.26716	
Contribution Toward Variance		0.0481	0.0678	0.1124	0.1768	
Multiple Correlation	0.6365					
Total Variance	0.4051					

TABLE 12

SUMMARY OF E_5 REGRESSION ANALYSIS
BASED UPON Z VALUES

	Variables				
	E_5	X_2	X_{16}	X_{17}	Constant
Gross Regression Coefficient		-0.73115	0.30243	0.44452	0.00000
Net Regression Coefficient		-0.31184	0.06562	0.15847	0.00000
Mean	0.00000	0.00000	0.00000	0.00000	
Standard Deviation	1.00000	1.00000	1.00000	1.00000	
Simple Correlation with E_5		-0.330	-0.038	0.171	
Partial Correlation with E_5		-0.5020	0.2554	0.4196	
Coefficient of Partial Determination		0.2520	0.0653	0.1761	
Importance Weight		0.42651	0.21699	0.35650	
Contribution Toward Variance		0.1092	0.1290	0.0500	
Multiple Correlation	0.5369				
Total Variance	0.2882				

which bring about the need for refinement.

> Suppose, however, that the regression between a dependent variable and one independent variable is calculated and a high positive correlation is found to exist. Then another independent variable is found which also correlates highly with the dependant variable in a positive manner and the multiple regression of the two independent variables is calculated. When this is done, the original value of the regression coefficient for the first independent variable may be reduced appreciably. Then a third independent variable is located which also correlates highly with the dependent variable in a positive manner, the process is repeated. At about this stage, however, two possibilities occur: (1) the previous pattern will be repeated, or (2) some of the previous regression coefficients will increase and take on unrealistic values while the last regression may become a negative. Also, the value of the constant term of the regression equation, which will have been reducing a little in the previous calculations, may undergo a sharp increase in this last calculation to further balance the adjustment being generated by the negative regression.

These effects do not damage the suitability of the completed model for predicting purposes, but they do cause the parameters to be obviously unrealistic for other analysis purposes. Since the primary use of the regression equation in this study is to show relationships between variables rather than for prediction purposes, it was urgent that the transformation be made. The gross coefficient for independent variable X_3 was 0.05695, indicating that for every unit change in X_3, the dependent variable, E_5, changed 0.05695 units. This is misleading inasmuch as only 0.01814 units of change, the amount of the net X_3 coefficient, are caused by a unit change in X_3 alone. The rest of the change in E_5 is caused by other independent variables, through interdependency with X_3.

The third and fourth lines of each regression summary table show the means and standard deviations, respectively. The former are used in calculating the constant term for the net regression model, and the

latter are required in deriving the coefficients of separate determination. The next line of the summary table lists the simple correlations of each independent variable with the dependent, and this is followed by the partial correlations for each independent variable. The latter factor determines which variable will be entered into the multiple correlation computation first. The highest partial correlation in Table II is shown for X_{19}, and this independent variable was the first to be entered into the regression model. The second highest was the X_3, but it was not entered second, since partial correlations must be recomputed for the outstanding independent variables at each step of the computation. After X_{19} was entered, the recomputation of partials reflected a higher value for X_8 than for X_3, so X_8 was entered second. The partial correlations are also used in deriving a weighting system for transforming the gross regression equation to net.

Each coefficient of partial determination is the square of the partial correlation, which it follows in the table, and its value constitutes a ratio explaining that portion of the variability in the dependent variable which may be attributed to specific independent variable when all other independent variables are held constant. The importance weights of the independent variables, which are listed next, show what portion each partial correlation bears to the total of all correlations of significant independent variables. Chapter II explains how these are used to refine multiple correlation equations so as to eliminate the effects of interdependency between independent variables and thus obtain parameters which show more realistic relationships between variables.

The next item is "contribution toward variance," and it indicates how much each entry into the multiple correlation increased the total

variance. The last two items are multiple correlation and total variance, respectively.

It is interesting to notice from Tables 11 and 12, that the regression using raw data and entirely different significant independent variables related to financial effort E_5 than did the regression using Z values. Significants in the former, with their respective contributions toward variance, were X_{19}, 0.1768; X_8, 0.1124, X_7, 0.0678; and X_3, 0.0481, total variance, 0.4051. In the latter, significant variables were X_{16}, 0.1290, X_2, 0.1092, and X_{17}, 0.0500, total variance of 0.2882. It is obvious that standardization of data from raw form to Z values has had a tremendous impact on the results. As has been pointed out earlier, however, Z values are more comparable from state to state than are raw data. They therefore can be expected to give a truer indication of dispersion of actual distribution with respect to the influences of the selected independent variables.

Despite the inherent limitations upon the use of standardized values, Guilford (1965: 515) pointed out, "In spite of these limitations, it is almost certain that derived scales, such as the standard-score scale, provide us with more nearly comparable values that do raw score scales." That is the reason why this researcher places more emphasis on the results obtained from regressing Z values than from using raw data.

Furthermore, Tate (1955) observed,

> Standard scores have several advantages in statistical theory and practice. They are algebraic and hence are tractable in mathematical discussion. Since a standard score is derived by dividing a deviation from the mean by the standard deviation, both of which are the same unit, it is an abstract quantity, i.e., a quantity independent of the original measurement unit.

He points out that the use of standard scores simplifies many statistical procedures.

> By their use an individual's performance in one test can be compared with his performance in a second, regardless of differences in the measurement units. Since they are algebraic, the standard scores of individuals in several tests can be combined into a composition score.

In the present study the measurement units are not different per se, but the units which were measured existed under circumstances that were quite different, causing the need for the data from different states to be transformed to a comparable base before being analyzed as a composite.

The relationship of student hours of preparation to grades awarded by a high-grading teacher will be different from such a relationship under a low-grading teacher. Similarly, there will be a difference between the relationships of personal income and school financial support in separate states where tax limitations are different, or where procedures of budget allocation and control are dissimilar. There are distinct advantages in transforming such statistical data to a more comparable base before proceeding with analyses of composite relationships.

As does Guilford, Tate defends the soundness of analyses using such standardized data, provided the distributions of raw scores are normal or approximately so. Even where nonnormal he points out (1955)

> ...that the standardization ratio has considerable stability of meaning except in markedly nonnormal distributions. The standard score transformation may be applied to the majority of distributions encountered in educational testing without introducing serious error.

Why were different independent variables more significant with Z values than with raw data? Two significance tests are embedded in the regression program, the selection of variables by F level and the 0.05

level t-test. The transforming of both dependent and independent variables, together with the resultant changes in distributions, makes it possible for these tests to select different variables from the different forms of data. Other possible explanations are the chance that minor non-linear relationships may exist between one or more of the included independent variables and the dependent variable, and the fact that the slope and/or level of the distributions have been changed during the transformation, as the value of the constant term has been lowered from the level obtained with raw data to a zero level when using standardized Z values.

In the analysis of E_5 regressions (Table 12), the total variance of only 0.2882 leaves a balance of 0.7118 unexplained. This tends to confirm the hypothesis that there is little association between socio-economic factors and local school financial effort, and educational leaders should look to other factors for the principal causes of variance in financial effort.

In Table 12, the summary of E_5 regression analysis based on Z values, although X_2 had the greatest partial correlation with E_5 and therefore was entered first, it does not make the greatest contribution toward variance. However, the net regression equation shows that a <u>unit</u> change in X_2, per capita net effective buying income, has a greater impact on E_5 than does X_{16}, per cent of population comprised of college educated adults, or X_{17}, median family income, when the effect of interdependency between independent variables is eliminated.

It is interesting to notice the comparison of significant variables and their respective coefficients of separate determination, as reflected by regression analyses of the separate states and of the

composite. This comparison is summarized in Table 13. The lack of consistency is obvious. It is observed that although X_{13}, per cent of population made up of 65-year-olds, was significant in only one state, it showed up strongly in the composite based upon raw data. However, it was eliminated in the composite using Z values. On the other hand, X_2, per capita net effective buying income, was omitted from significance in the raw data composite despite its being significant in two of the four states, but was included in the composite based on Z values. X_{11} was also significant in two states, but data for this variable were unavailable in Illinois and therefore had to be eliminated from consideration in the composite analyses.

The coefficients of separate determination shown on Table 13 and similar tables later in this report were calculated by multiplying the beta coefficients by the simple correlation between the independent and the respective dependent variables. The beta coefficients were obtained by multiplying the gross regression coefficients by the ratio of the standard deviation of the independent variable to the standard deviation of the dependent variable.

Relationship of 1960 socioeconomic factors to financial effort E_7

Tables 14 and 15 summarize regression analyses similar to those presented in the previous section, and they present even more forcefully the contrast between results obtained from using Z values as compared to those based upon raw data. The total variance from significant variables is only 0.2549 when using Z values, whereas variance reaches 0.7550 with raw data. If one accepts Guilford's conclusion that standard-score scales provide us with more comparable data than do raw-score scales, he will realize that by far the greater portion of the

TABLE 13

COMPARISON OF COEFFICIENTS OF SEPARATE DETERMINATION FOR SOCIOECONOMIC VARIABLES FOUND TO BE SIGNIFICANT IN PREDICTING FINANCIAL EFFORT E_5

	Coefficient of Separate Determination[a]					
	Based on Raw Data					Based on Z Values
Variable	Fla.[b]	Ga.[c]	Ky.[d]	Ill.[e]	Composite	Composite
X_2 (per capita net effective buying income)	0.06N			0.21N		0.24N
X_3 (% ADA to total population)				0.57P	0.03P	
X_5 (state revenue receipts per pupil)			0.06P			
X_7 (% of families with $10,000 income)	0.25P				0.10P	
X_8 (non-white % of population)					0.12N	
X_{11} (rural non-farm % of population)	0.19N		0.76P			
X_{16} (college educated adults % of population)						0.03N
X_{17} (median family income)			0.09N			0.08P
X_{19} (65 year-olds, % of population		0.16N			0.15P	
X_{20} (ADA % of school age population)	0.11P					

[a] The P or N following the coefficient indicates a positive or negative simple Correlation with dependent variable.

[b] Source: Hopper 1965

[c] Source: King 1965

[d] Source: Adams 1965

[e] Source: Quick 1965

TABLE 14

SUMMARY OF E_7 REGRESSION ANALYSIS
BASED UPON RAW DATA

	Variables								
	E_7	X_2	X_3	X_{12}	X_{17}	X_{18}	X_{19}	X_{22}	Constant
Gross Regression Coefficient		0.00093	0.10898	-0.02211	0.00025	-0.23203	0.11412	-0.00241	-1.77862
Net Regression Coefficient		0.00014	0.02676	-0.00175	0.00003	-0.02237	0.02609	-0.00022	1.03862
Mean	1.78354	1618.16393	20.05598	84.43030	4746.67212	2.23443	9.54016	36.37048	
Standard Deviation	1.06337	441.64314	4.39468	5.83733	1291.28027	0.73864	3.73092	54.77355	
Simple Correlation with E_7		0.636	0.186	0.327	0.608	0.543	0.444	0.031	
Partial Correlation with E_7		0.3719	0.6257	-0.2014	0.2883	-0.2457	0.5827	-0.2329	
Coefficient of Part. Determination		0.1383	0.3915	0.0406	0.0831	0.0604	0.3395	0.0542	
Importance Wt.		0.14592	0.24551	0.07902	0.11312	0.09641	0.22864	0.09138	
Contribution Toward Var.		0.4042	0.1678	0.0105	0.0224	0.0145	0.1213	0.0142	
Multiple Correlation	0.8683								
Total Variance	0.7550								

TABLE 15

SUMMARY OF E_7 REGRESSION ANALYSIS
BASED UPON Z VALUES

	Variables					
	E_7	X_3	X_5	X_{19}	X_{22}	Constant
Gross Regression Coefficient		0.34001	-0.36793	0.33905	0.24525	0.00000
Net Regression Coefficient		0.08561	-0.05849	0.05412	0.04977	0.00000
Mean	0.00000	0.00000	0.00000	0.00000	0.00000	
Standard Deviation	1.00000	1.00000	1.00000	1.00000	1.00000	
Simple Correlation with E_7		0.019	-0.306	0.242	0.220	
Partial Correlation with E_7		0.3102	-0.3298	0.3420	0.2500	
Coefficient of Partial Determination		0.0962	0.1088	0.1170	0.0625	
Importance Weight		0.25179	0.26769	0.27760	0.20292	
Contribution Toward Variance		0.0443	0.0938	0.0673	0.0435	
Multiple Correlation	0.5048					
Total Variance	0.2549					

variance in financial effort must be explained by factors other than the studied socioeconomic variables.

Another difference in the analyses of the two types of data is that the transformation of the gross regression equation to net has a greater impact upon the coefficients of the raw data model. Each is more sharply reduced than are the coefficients of the standardized data equation, most of the coefficients being decreased to about 10 per cent of their gross value compared with reductions to approximately 25 per cent for the standardized data coefficients. On the other hand, the raw data constant terms receive a similarly greater but offsetting impact. The same effect was found for the $\hat{E}_5$ equations; in each case the constant term was changed from a negative value in the gross equation to a positive value in the net equation, thus counterbalancing the reduction in size of the coefficients. In the Z value equation there was no change in the constant term, inasmuch as standard scores do not generate a constant term, and the transformation process uses the gross constant term as a multiplier in creating a constant term for the net equation, causing the elimination of the constant term from the net equation also.

The effect of reduction in overall deviation which was caused by standardization of data may be largely responsible for the difference in the numbers of significant variables with the two different types of data. Table 16 shows that the composite analysis of raw data produces seven significant independent variables as compared with only four with standard scores. Three of these are common to both regressions: X_3, ADA as a per cent of total population, X_{19}, 65-year-olds as a per cent of population, and X_{22}, percentage increase in population over the previous decade. The former two were each significant in only one of the

TABLE 16

COMPARISON OF COEFFICIENTS OF SEPARATE DETERMINATION FOR SOCIOECONOMIC VARIABLES FOUND TO BE SIGNIFICANT IN PREDICTING FINANCIAL EFFORT E_7

	Coefficient of Separate Determination[a]					
	Based on Raw Data					Based on Z Values
Variable	Fla.[b]	Ga.[c]	Ky.[d]	Ill.[e]	Composite	Composite
X_2 (per capita net effective buying income)					0.26P	
X_3 (% ADA to total population)				0.78P	0.08P	0.01P
X_5 (state revenue receipts per pupil)		0.36N		-0.10P		0.11N
X_{12} (% of 14-17 year-olds attending school)			0.37P		0.04P	
X_{17} (median family income)					0.18P	
X_{18} (% of married couples not owning homes)					0.09N	
X_{19} (65 years-olds, % of population)	0.32P				0.18P	0.08P
X_{22} (% population increase in last decade)					0.004N	0.05P

[a] The P or N following the coefficient indicates a positive or negative simple correlation with the dependant variable.

[b] Source Hopper 1965

[c] Source King 1965

[d] Source Adams 1965

[e] Source Quick 1965

separate state studies, Illinois and Florida, respectively. The latter was significant in none. On the other hand, X_5, state revenue receipts per pupil, was significant in two states--positively in Georgia and negatively in Illinois. It was found to be non-significant in the raw data composite analysis, but proved to be significant in the standardized data composite.

In searching for variables that had a tendency to remain significant over a period of years, four were found that qualified, as indicated below.

Coefficients of Separate Determination for Variables Found to be Significant in Both 1950 and 1960 Composite Analyses

	1950		1960	
Variable	Raw Data Analysis	Z Value Analysis	Raw Data Analysis	Z Value Analysis
X_2		0.24	0.26	
X_3	0.03		0.08	0.01
X_{17}		0.06	0.18	
X_{19}	0.15		0.18	0.08

Even among the few variables that were consistent enough to be significant in both periods, there was a lack of consistency as to which regression showed them to be significant. This lack of consistency causes this researcher to further doubt that a substantial association existed between the studied socioeconomic factors and financial effort.

All of the regression analyses discussed in this chapter thus far have incorporated t-tests for significance in order to eliminate several of the variables which the multiple regression program had allowed to enter, based upon their F levels. The last section of the chapter on

procedures discussed the feasibility of gaining increased accuracy by retaining all variables which had been thus accepted, and Tables 17 and 18 are presented in order to demonstrate this effect. Table 17 shows that all 17 of the raw data independent variables have been accepted into the regression equation, and Table 18 indicates the inclusion of all Z value variables with the exception of X_{15}, the per cent of employed persons engaged in manufacturing. Both of these tables show an increase in variance from the inclusion of more variables. In Table 17 the increase is slight, from 0.7550 with the t-test to 0.7723 without it. The elimination of the t-test appears to have less effect where the number of significant variables by t-test are greater. This was the case for Table 17, the E_7 raw data composite analysis. The impact was greater for the corresponding Z value analysis, Table 18, where there had been only four significant variables by t-test. Eliminating the t-test resulted in the number of included independent variables increasing from four to 17, and the total variance increasing from 0.2549 to 0.3663.

It is suggested that where the retention of all variables accepted by the multiple correlation program is considered undesirable, that some method of determining significance be found which is superior to the t-test, as applied here. One possibility would be the rejection of variables which produce an increase in total variance of less than 0.01. This type of significance test would be extremely simple to apply, since the summary table (see Table 7) lists the independent variables in the order that they were accepted and shows the amount of contribution which each made to total variance. One could determine at a glance the last acceptable step in the computation and could immediately identify the

TABLE II

NUMERICAL DATA FOR THE CONVERGENCE STUDY

Average Temperature Good Agreement		0.00000	0.00000	0.00000	-0.00039	0.00000	0.00585	-0.00000	0.00000	-0.00000	0.00000	0.00000	0.00000	-0.00000	-0.00000	0.00000	0.00000	-0.00000	-0.00000
Net Deposition Coefficient		0.00000	0.00000	0.00000	-0.00000	0.00000	0.00000	-0.00000	0.00000	-0.00000	0.00000	0.00000	0.00000	-0.00000	-0.00000	0.00000	0.00000	-0.00000	-0.00000
Mean	2000A	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Boundary Deposition	.00017	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Temple Electrostatics with H		-0.0118	0.035	0.106	-0.305	-0.011	0.338	-0.130	0.352	0.351	0.101	0.251	0.000	0.000	0.000	0.000	0.000	-0.000	-0.000
Hot Air Spreading with H		0.0961	0.0271	0.0503	-0.0736	0.0005	0.0810	0.0000	-0.0000	0.0000	-0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-0.0000	-0.0000
Excess Deposited Mass Contamination		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Temperature Weight		0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Final Mass Fraction Removed Maximum		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Spline Interpolation	0.0000																		
Total Maximum	0.0000																		

TABLE 10

SUMMARY OF E_j SENSITIVITY ANALYSIS WITHOUT H-TEXT
BASED UPON 7 VALUES

	Water Inlet Mark																Comments
	E_0	E_1	E_2	E_3	E_4	E_5	E_6	E_7	E_{10}	E_{11}	E_{12}	E_{13}	E_{14}	E_{15}	E_{16}	E_{17}	
Gross Gradient on Exit Blade		0.81111	0.48854	0.46211	-0.21977	0. 448	-0.15008	-0.19581	0. 8134	-0.45300	0.13985	0.31383	0.25788	-0.20111	0.00000	-0.46348	0.38471	0.00000
Net Regrind Wax Coefficients	0.00000	0.80486	0.48126	-0.07439	0.00413	-0.00363	-0.00112	0.00045	-0.04414	0.00881	0.01308	0.0 111	-0.04862	0.03911	-0.00464	0.03097	0.00000
Mean	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	
Standard Deviation	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	
Simple Correlation with E_j		0.14 0.	0.190	0.0 3	-0.306	-0 00	0.398	-0.036	0.300	0.080	0.127	0.018	0.337	-0.160	0.302	0.188	0.300
Partial Correlations with E_j		0.1990	0 0041	0.3004	-0 1684	0.1033	0.0000	0 0557	0.1008	-0.3065	0.1005	0.3835	0.1040	-0.1888	0.3365	0.1542	0.3536
Coef Extent of Part of Contamination		0.0365	0 0030	0.0518	0.0207	0.1102	0.0000	0 0032	0.1105	0.0658	0.0113	0 0500	0.0964	0.0083	0.0956	0.0230	0.0834
Feed cone Weight		0.0194	0 0136	0.0048	0.0000	0 0000	0.0000	0 0000	0 0057	0. 0142	0.00 65	0 0000	0.0141	0.0035	0 0138	0.0000	0 0000
Cont Reaction Thermo Problems		0.0000	0 0012	0.0063	0.0035	0 0038	0.0062	0 0000	0 0073	0. 15	0.0056	0.0110	0.0156	0.0051	0.0031	0.0110	0.0055
Mul tiple Correlation	0.0053																
Total Variance	0 3663																

variables considered significant and the regression equation adopted as being the most significant. Furthermore, this approach would immediately inform the administrator of the amount of variance eliminated by the non-acceptance of all variables. If such a significance procedure were applied to the E_7 Z value regression analysis, for example, seven variables would be rejected for contributing less than 0.01 to variance, a total loss of only 0.0202. The margin could be regulated by the amount of tolerance considered allowable, whereas the consistent application of the 0.05 level t-test was a less informed approach which failed to consider the overall effect upon accuracy.

Even with 16 independent variables included in the regression model, the standardized data analysis still shows that only about one-third of the total variance in financial effort has been accounted for, and it behooves our educational leaders to search for other causes.

Relationship of Socioeconomic Factors to Local Elasticity of Demand for Education

There always have been more demands for economic goods than the resources of society have been able to fulfill, and economists believe this situation will continue. Each demand must compete with numerous other demands for a share of the available supply, the stronger the demand, the greater will be its share. Shultz (1961) and Fabricant (1959) have shown that it is in the best economic interest of our nation for education to exert a strong demand for an adequate share of economic goods.

The primary concern of this study was the extent to which education was competing for economic goods of the local districts. This section of the study specifically examines the responsiveness of this demand

to changes in disposable personal income. Where there has been an increase in per capita buying power, what portion of the increase was the average individual willing to spend for education? This responsiveness has been called "elasticity of demand for education" (Brazer, 1959, Fabricant, 1959, Hirsch, 1959, and McLoone, 1961). Basically, this is a measure of what percentage change in local school revenue receipts per pupil accompanied each percentage change in net effective buying income per capita. The formula used in this study for calculating elasticity of demand for education gives essentially this result, although it has been sophisticated to make it more suitable for statistical analysis. The chapter on procedures gives the exact formula which was used and discusses it further.

The coefficients of elasticity of demand for education were computed for all 122 districts in the previous studies of Florida, Georgia, Kentucky, and Illinois, and average elasticities were calculated for the nine-year periods 1945 through 1954 and 1953 through 1962. The symbols used for these average elasticities are $\bar{0}_3$ and $\bar{0}_5$, respectively. In the present research study, these average elasticities were treated as a composite sample and were regressed against the 17 selected socioeconomic variables for these districts, first using raw data, then standardized data (Z values). The following two subsections are devoted to the results of these step-wise multiple regressions and their interpretations.

Relationship of 1950 socioeconomic factors to elasticity of demand $\bar{0}_3$

Tables 19 and 20 show the results of the three regressions. Each produces only one significant variable, X_{Z}, per capita net effective buying income. The total variance associated with this variable is 0.0497 for the Z value regression, and 0.0434 using raw data. Had the

t-test not been used to reject all except one variable in each regression, the total variance would have been shown as 0 1891 and 0 1915, respectively with all 17 independent variables included. The fact that both the raw and standardized data regressions retained only one variable in the significant regression equation is a coincidence caused by the fact that a large drop in contribution toward variance occurred between X_2 and the next most influential variable, X_{22}, in both regressions. This drop created a gap wide enough that the cutoff of the t-test occurred in this gap for all three computations.

In comparing Tables 19 and 20, it is interesting to notice that the forms of the regressions are markedly different. The raw data model has a constant term of 0.35062 and an extremely small coefficient for the single significant variable, a value of only 0.00036. The regression based on Z values, on the other hand, has a zero constant term and a sizable coefficient, amounting to 0 20844. The curve of the latter regression equation would begin at a lower value and slope upward at a much faster rate as X_2 increased. For both regressions the transformation of the gross regression to net is completely ineffective. The net equations are all identical to the gross equations. The reason for this is that the function of the transformation is to eliminate the effects of interdependency between independent variables, and there can be no interdependency for a single independent variable, so no change is effected by applying the transformation procedure.

It can be observed from Table 21 that large samples can produce entirely different significance results than do smaller subsamples of the same group of variables. Whereas variable X_{21} was found to be significant in Kentucky and X_{22} was significant in both Georgia and

TABLE 19

SUMMARY OF O_3 REGRESSION ANALYSIS
BASED UPON RAW DATA

	Variables		
	O_3	X_2	Constant
Gross Regression Coefficient		0.00036	0.35062
Net Regression Coefficient		0.00036	0.35062
Mean	1.39060	1077.86064	
Standard Deviation	0.62929	415.50853	
Simple Correlation with O_3		0.099	
Partial Correlation with O_3		0.0990	
Coefficient of Partial Determination		0.0098	
Importance Weight		1.0000	
Contribution Toward Variance		0.0497	
Multiple Correlation	0.2230		
Total Variance	0.0497		

TABLE 20

SUMMARY OF O_3 REGRESSION ANALYSIS
BASED UPON Z VALUES

	Variables		
	O_3	X_2	Constant
Gross Regression Coefficient		0.2044	0.00000
Net Regression Coefficient		0.2044	0.00000
Mean	0.00000	0.00000	
Standard Deviation	1.00000	1.00000	
Simple Correlation with O_3		0.208	
Partial Correlation with O_3		0.2080	
Coefficient of Partial Determination		0.0433	
Importance Weight		1.0000	
Contribution Toward Variance		0.0434	
Multiple Correlation	0.2084		
Total Variance	0.0434		

TABLE 21

COMPARISON OF COEFFICIENTS OF SEPARATE DETERMINATION FOR SOCIOECONOMIC VARIABLES FOUND TO BE SIGNIFICANT IN PREDICTING ELASTICITY OF DEMAND 0_3

	Coefficient of Separate Determination[a]					
	Based on Raw Data					Based on Z Values
Variable	Fla.[b]	Ga.[c]	Ky.[d]	Ill.[e]	Composite	Composite
X_2 (per capita net effective buying income)					0.02P	0.04P
X_{21} (population of district)		0.36P				
X_{22} (% population increase in last decade)	0.17N		0.17N			

[a] The P or N following the coefficient indicates a positive or negative simple correlation with the dependent variable

[b] Source Hopper 1965

[c] Source King 1965

[d] Source Adams 1965

[e] Source Quick 1965

Illinois, neither are significant in the composite study. And X_2, which was found to be significant in both composite analyses, was recognized in none of the four states.

In one respect, however, all three composite regressions and all four state regressions are in agreement: socioeconomic variables account for very little of the variance in elasticity of demand for education. All the 1950 regressions thereby tend to confirm the hypothesis that there is little association between socioeconomic variables and elasticity of demand for education.

Relationship of 1960 socioeconomic factors to elasticity of demand 0_5

The 0_5 regression summaries shown on Tables 22 and 23 confirm the indications of the 0_3 analyses that the strength of relationship between socioeconomic factors and elasticity of demand for education is slight. When using raw data the total variance is only 0.1856, and when the computation is based upon Z values, it drops to 0.1548. Both the 1950 and the 1960 regressions substantiate the hypothesis that there was little association between socioeconomic factors and elasticity of demand for education. The relationship was even weaker for elasticity than it was for effort. Why this is true is at this point a matter of conjecture. However, referring back to the first section in this chapter, Consistency of Effort and Elasticity, an example was given to show that small marginal changes in effort can be associated with extreme fluctuations in elasticity of demand. In the earlier analyses, a comparison of consistencies of effort and elasticity showed that while financial effort was rising rather uniformly over a ten year time span, with very little shifting of relative positions within the sample, elasticity of demand for education fluctuated without any discernible pattern,

TABLE 22

SUMMARY OF O_5 REGRESSION ANALYSIS
BASED UPON RAW DATA

	Variables				
	O_5	X_{14}	X_{15}	X_{22}	Constant
Gross Regression Coefficient		0.02336	0.01564	0.00296	-0.14608
Net Regression Coefficient		0.00756	0.00573	0.00092	0.69687
Mean	1.12050	34.29835	22.88852	36 37048	
Standard Deviation	.79375	7.55683	13.06915	54 77359	
Simple Correlation with O_5		0.330	0.254	0.030	
Partial Correlation with O_5		0 2229	0.2523	0.2133	
Coefficient of Partial Determination		0.0497	0.0637	0 0455	
Importance Weight		0 3237	0.3664	0 3099	
Contribution Toward Variance		0.1089	0.0377	0.0390	
Multiple Correlation	0 4308				
Total Variance	0.1856				

TABLE 23

SUMMARY OF D_5 REGRESSION ANALYSIS
BASED UPON Z VALUES

		Variables		
	O_5	X_5	X_8	Constant
Gross Regression Coefficient		-0.26978	-0.27115	0.00000
Net Regression Coefficient		-0.13441	-0.13606	0.00000
Mean	0.00000	0.00000	0.00000	
Standard Deviation	1.00000	1.00000	1.00000	
Simple Correlation with O_5		-0.285	-0.287	
Partial Correlation with O_5		-0.2806	-0.2826	
Coefficient of Partial Determination		0.0787	0.0799	
Importance Weight		0.49822	0.50178	
Contribution Toward Variance		0.0725	0.0822	
Multiple Correlation	0.3934			
Total Variance	0.1548			

causing a complete reordering of relative ranks. It is believed that this tendency to fluctuate vigorously in response to changes in personal income or school revenue causes a weaker relationship to socioeconomic variables.

A comparison of Tables 22 and 23 reveals an effect which has been consistent throughout the analyses in this study--a reduction in the number of significant variables when raw data are standardized, with different variables being significant for the two different forms of data. For the composite raw data analysis, three variables were found to be significant: X_{14}, per cent of 14-or more year-old females in the labor force, X_{15}, per cent of employed persons engaged in manufacturing, and X_{22}, per cent increase in population over the decade. The standardized data analysis found only two variables significant: X_5, state revenue receipts per pupil, and X_8, per cent of the population that is non-white. Even where the t-test is eliminated, there is still a greater number of independent variables brought into the regression equation when raw data are used. This can be seen by comparing Tables 25 and 26, where the former, presenting the raw data summary, includes 17 independent variables compared to 16 for the latter. This comparison has been consistent throughout the study, for all regressions where the t-test was eliminated.

Another comparison of interest which has been rather consistent is the number of included variables and the amount of variance. The raw data analysis on Table 22 has three independent variables compared to only two on the Z value analysis of Table 23, and the variance for the raw data regression is somewhat higher, 0.1856 compared to 0.1548. When

the t-test is eliminated, however, the numbers of included variables are relatively more even, 17 to 16. Similarly, the total variances are more even, 0.2523 and 0.2666, respectively.

Table 24 shows a lack of consistency in selection of significant variables between states as well as between composite computations. Of the seven significant variables in the individual states, there is only one agreement between states. Both Georgia and Illinois recognize X_2, per capita net effective buying income, as significant. However, neither composite computation finds this factor as significantly influential. As shown by Tables 25 and 26, it contributes only 0.0003 to total variance in the composite raw data analysis, and 0.0089 in the composite Z value analysis. This researcher finds this lack of consistency very disturbing. One would expect a variable which is consistently influential in the individual states to be similarly influential in a composite analysis, particularly where the relative effects of dispersions are retained in the composite by combining Z values rather than raw data. Further remarks on this phenomenon are made in the final chapter.

It is suggested that a comparison of Tables 23 and 26, the composite Z value summaries with and without the t-test, clearly reveals the superiority of retaining more variables than the 0.05 level t-test would permit. First of all, the total variance when retaining all variables entered by the multiple correlation program was 72 per cent greater than when the t-test was used. The t-test had eliminated all except two independent variables. All of the variance is real and should be considered. The writer acknowledges the practicality of eliminating variables which produce negligible effect on the relationships being studied, but the elimination procedure should provide a cutoff established

TABLE 24

COMPARISON OF COEFFICIENTS OF SEPARATE DETERMINATION FOR SOCIOECONOMIC VARIABLES FOUND TO BE SIGNIFICANT IN PREDICTING ELASTICITY OF DEMAND O_S

	Coefficient of Separate Determination[a]					
	Based on Raw Data					Based on Z Values
Variable	Fla.[b]	Ga.[c]	Ky.[d]	Ill.[e]	Composite	Composite
X_2 (per capita net effective buying income)	0.11P			0.21P		
X_4 (federal revenue receipts per pupil)	0.19N					
X_5 (state revenue receipts per pupil)				0.24N		0.08N
X_6 (non-white % of population)	0.14N					0.08N
X_{14} (% of 14-or-more year-old females in labor force)					0.07P	
X_{15} (% of employed persons in manufacturing)			0.34P		0.08P	
X_{22} (% population increase in last decade)	0.11P				0.01P	

[a] The P or N following the coefficient indicates a positive or negative simple correlation with the dependent variable.

[b] Source: Hopper 1965

[c] Source: King 1965

[d] Source: Adams 1965

[e] Source: Quick 1965

by informed judgment, either through pre-programming or posteriori personal judgment.

The multiple correlation program provides information to facilitate either of these approaches, as summarized by Table 26. The contribution which each variable makes toward variance is given, as well as the total variance for all variables, and the comparison of these respective values provides a very practical way of establishing a cutoff to the elimination procedure. For example, restricting the eliminations to those variables which contribute less than 0.0050 to variance would eliminate nine variables and a total of only 0.0176 from variance, or 6.6 per cent of the gross variance accounted for.

It might be advantageous to also set a maximum percentage of total variance for which elimination would be permitted. With this limitation established at 5.0 per cent, the cutoff for the composite 2 value regression (Table 26) would eliminate seven variables, causing a total reduction in variance of 0.0089, or only 3 3/4 per cent of gross variance from all variables.

A procedure with these limitations would assure that violence would not be done to statistical accuracy in reducing the recognized variables to a workable number. For the purposes of the present study, however, there is no particular hardship in retaining all variables entered by the correlation program, and it is felt advisable to do so in order to demonstrate the effect of each variable.

Fortunately, however, there is no doubt of the conclusion to be drawn from the various regressions involving elasticity of demand, regardless of the use of significance tests or whether the data were expressed in raw form or standardized. All regressions showed a weak

Table 15

Summary of C_6 catalytic combustion kinetics methods evaluated

Brook Hydrogen Sandwich																		
Dual Hydrogen Sandblast																		
Rose																		
Hydrogen Sanitation																		
Simple Combustion Unit																		
Hot Air Engine with																		
Digital Laser Hydrogen																		
Hydrogen Network																		
Combustion Gauge																		
Air Jet Separation																		
Vapor Hydrogen																		

TABLE 26

SUMMARY OF B_0 REGRESSION ANALYSIS FOR RUNS 8 THRU 7
BASED UPON 8 VALUES

		Variables													
		0	x_1	x_2	x_3	x_4	x_5	x_6	x_7	x_8	x_9	x_{10}	x_{11}	x_{12}	Constant
Least Regression Coefficient		0.16798	-0.13691	-0.10185	-0.10188	-0.0118	-0.15716	-0.26138	0.30804	-0.01301	0.00545	0.13857	0.07535	0.0181	0.0149	-0.73638	0.0000
Mid Regression Coefficient		0.00000	-0.05711	-0.09410	-0.01815	-0.0118	-0.00765	-0.05470	0.02850	-0.01209	0.00172	0.04871	0.00000	0.00000	0.00000	-0.01796	0.0000
Mean	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.0000
Standard Deviation	1.00000	0.00000	0.00000	1.00000	0.00000	1.00000	0.00000	1.00000	0.00000	1.00000	0.00000	1.00000	0.00000	1.00000	0.00000	1.00000	0.0000
Simple Correlations with B_0		-0.0819	0.259	-0.752	-0.195	-0.151	0.710	-0.387	0.391	0.164	0.059	0.244	0.019	0.365	0.111	-0.891	0.000
Partial Correlation with B_0		0.0180	0.1309	-0.9782	-0.1105	-0.0637	-0.917 7	-0.9133	0. 869	-0.1783	0.0610	0.1259	0.0131	0.0804	0.0 39	-0.8274	0.0179
Coefficient of Partial Determination		0.0018	0.0137	0.9569	0.0188	0.0013	0.8881	0.8340	0.7556	0.0301	0.0041	0.0159	0.0005	0.0068	0.0000	0.0056	0.0003
Importance We ght		0.0643	0.1327	0.9687	0.0788	0.0545	0.8855	0.8600	0.8015	0.0778	0.0345	0.0612	0.0095	0.0000	0.0000	0.0513	0.0340
Contribution Toward Variance		0.0135	0.0088	0.809	0.0159	0.0011	0.7492	0.7258	0.6138	0.0066	0.0029	0.0052	0.0008	0.0000	0.000	0.0043	0.0029
Multiple Correlation	0.9 96																
Total Variance	0.9966																

relationship between elasticity and socioeconomic variables, indicating that educational leaders should look elsewhere for the causes of change in elasticity of demand for education.

Relationship of Socioeconomic Factors to Local School Revenue Receipts per Pupil

It is generally accepted that a higher quality of education will normally be concomittant with a higher expenditure of funds per pupil. Not only does this appear to be an obvious common-sense conclusion, but Johns and Morphet (1960) have supported it through experimental research. It should not be surprising that one of the most popular approaches to improving education has been the investigation of how financial support per pupil could be improved. Several of the studies mentioned in Chapter I attempted to account for variations in per pupil expenditure, and this part of the current study follows a similar approach. Local school revenue receipts per pupil for 1960 (essentially the same thing as local school expenditures per pupil) have been regressed against 1960 socioeconomic factors for the selected 122 school districts, and the results are presented in Tables 27 and 28.

These regression summaries show that the bulk of the variance in local school revenue receipts per pupil is associated with net effective buying income per capita, and to this extent they tend to confirm the hypothesis concerning revenue receipts per pupil. However, they deny it in another respect. Whereas it was hypothesized that net effective buying income per capita was the only socioeconomic factor significantly related to financial support per pupil, several other significant variables were found, although their combined total impact was small

TABLE 27

SUMMARY OF R_4 REGRESSION ANALYSIS
BASED UPON RAW DATA

	Variables							
	R_4	X_2	X_7	X_8	X_{16}	X_{19}	X_{22}	Constant
Gross Regression Coefficient		0.15936	5.01071	-1.15323	4.67199	9.23362	-0.38505	-219.64525
Net Regression Coefficient		0.03925	0.49581	-0.14686	.052658	3.20988	-0.06434	71.32152
Mean	168.25732	1618.16393	10.50491	15.04016	4.42049	9.54016	36.37048	
Standard Deviation	132.00801	441.64314	5.07090	13.24465	3.72405	3.73092	54.77359	
Simple Correlation with R_4		0.847	0.749	-0.333	0.637	0.418	-0.016	
Partial Correlation with R_4		0.5045	0.2027	-0.2609	0.2309	0.5073	-0.3423	
Coefficient of Part. Determination		0.2545	0.0411	0.0681	0.0533	0.2574	0.1172	
Importance Wt.		0.24627	0.09895	0.12735	0.11271	0.24763	0.16709	
Contribution Toward Var		0.7177	0.0153	0.0110	0.0097	0.0564	0.0158	
Multiple Correlation	0.9110							
Total Variance	0.8299							

TABLE 28

SUMMARY OF R_4 REGRESSION ANALYSIS
BASED UPON Z VALUES

	Variables								
	R_4	X_2	X_3	X_5	X_{13}	X_{16}	X_{17}	X_{19}	Constant
Gross Regression Coefficient		0.36581	-0.17666	-0.30381	-0.22257	0.25512	0.14079	0.12155	0.00000
Net Regression Coefficient		0.07797	-0.03174	-0.05564	-0.01820	0.03533	0.00541	0.00201	0.00000
Mean		0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	
Standard Deviation	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	
Simple Correlation with R_4		0.763	-0.639	-0.730	0.492	0.564	0.537	0.209	
Partial Correlation with R_4		0.5462	0.4604	-0.4693	-0.2095	0.3549	0.0985	0.4237	
Coefficient of Part. Determination		0.2983	0.2120	0.2202	0.0439	0.1260	0.0097	0.1795	
Importance Wt.		0.21314	0.17967	0.18314	0.08716	0.13850	0.03844	0.16535	
Contribution Toward Var		0.5819	0.0128	0.0407	0.0110	0.0165	0.0083	0.0767	
Multiple Correlation	0.8654								
Total Variance	0.7489								

A summary of the significant variables and their respective contributions to variance is shown below for both the raw data and Z value analyses.

	Raw Data	Z Values
X_2 (per capita net effective buying income)	71.71%	58.19%
X_3 (per cent ADA to total population)		1.29
X_5 (state revenue receipts per pupil)		4.07
X_7 (per cent of families with $10,000 income)	1.53	
X_8 (non-white per cent of population)	1.10	
X_{13} (median school years completed by adults)		1.10
X_{16} (college educated adults, per cent of population)	0.97	1.65
X_{17} (median family income)		0.93
X_{19} (per cent of population 65 or more years old)	5.64	7.67

The 71.71 per cent of variance contributed by per capita net effective buying income in the raw data analysis is similar to the 75 per cent of variance in per pupil expenditures which Hirsch (1959) found to be accounted for by per capita income fluctuations. The current Z value analysis, however, indicated only 58.19 per cent of the variance as attributable to personal disposable income per capita. This is much smaller than either Hirsch's findings or the raw data indication,

reflecting the possibility that reduction in range from standardization of data may have resulted in an excessive reduction in the resultant variance.

The next most influential factor, both in the raw data and Z value analyses, was X_{15}, the per cent of population comprised of 65-or-more year-olds. This was surprising, inasmuch as X_{15} was significant in only one of the four states originally studied, as indicated by Table 29. However, the fact that it was significant only in Florida does not mean that it completely lacked association in the other three states. It merely means that the amount of association fell below the point where the t-test for significance happened to cut off. The fact that the previous studies failed to present any information about the relationships of these variables which were non-significant makes it difficult to investigate the contributory influences from the separate states in bringing about the significance in the composite.

The only other variable which is significant for both analyses, raw data and Z value, is X_{16}, the per cent of total population consisting of adults (25-or-more year-olds) with at least four years of college education. Table 29 shows a coefficient of separate determination of 0.14 for the Z value composite analysis and 0.08 in the raw data analysis. In no case did any of the related research studies find this factor to be influential.

However, a similar factor, median school years completed by adults (X_{13}), has been recognized in several studies, and the Z value analysis of this study indicates that it contributed 1.10 per cent of the total variance. It would appear, then, that the effect of education has a slight tendency to be circular: the higher the level of education

TABLE 29

COMPARISON OF COEFFICIENTS OF SEPARATE DETERMINATION FOR SOCIOECONOMIC VARIABLES FOUND TO BE SIGNIFICANT IN PREDICITNG LOCAL REVENUE RECEIPTS PER PUPIL R_4

	Coefficient of Separate Determination[a]					
	Based on Raw Data					Based on Z Values
Variables	Fla.[b]	Ga.[c]	Ky.[d]	Ill.[e]	Composite	Composite
X_2 (per capita net effective buying income)	0.50P	0.49P	0.43P		0.45P	0.28P
X_3 (% ABA to total population)		0.17N		0.26N		0.11N
X_5 (state revenue receipts per pupil)				0.25N		0.22N
X_7 (% of families with $10,000 income)				0.25P	0.14P	
X_8 (non-white % of population)					0.04N	
X_{10} (rural non-farm % of population)			0.43N			
X_{13} (median school years completed by adults)						0.11P
X_{16} (college educated adults % of population)					0.08P	0.14P
X_{17} (median family income)						0.08P
X_{19} (65-year-olds, % of population)	0.22P				0.11P	0.03P
X_{21} (population of district)		0.15P		-0.01P		
X_{22} (% population increase in last decade)					0.003N	

[a] The P or N following the coefficient indicates a positive or negative simple correlation with the dependant variable.

[b] Source Hopper 1965

[c] Source King 1965

[d] Source Adams 1965

[e] Source Quick 1965

for previous generations, the more the financial support for each pupil in the current generation.

State revenue receipts per pupil (X_5) was significant only in Illinois in the previous studies, but the standardized data composite analysis finds that this factor contributes 4 07 per cent of the total variance. The net regression equation, as shown on Table 28, shows that for every unit increase in state revenue receipts per pupil, there is a corresponding decrease in local school revenue receipts of 0 05564 units, when the effects of interdependency between independent variables are eleiminated. It is expected that the strongly negative relationship in Illinois has carried over into the composite analysis, but one cannot be sure of the extent to which this caused the relationship in the composite, without knowing the relationships in the other states. And no information was given in the previous studies regarding strength of relationship except where significance was indicated by the 0 05 level t-test.

The revenue receipts form the state governments in this four-state area were associated with a decline in local revenue receipts. In addition to the equalization function of foundation programs, inducement provisions often stimulate increases in the levels of local revenues. This secondary effect was not being realized in 1960 for the composite area.

Information regarding direction and strength of relationships for all variables which were brought into the multiple regression computations, whether significant by t-test or not, are included on Tables 30 and 31, composite raw and Z value analyses, respectively. It was surprising to find that the inclusion of non-significant variables added

Table 10

COMPARISON OF R_0 ESTIMATES FROM DIFFERENT METHODS

Results for Ebola outbreak

	R_0		R_0	R_0	R_0	r_1	$r_{1/2}$							
Group Communication Coefficient	=0.048	1.13882	=0.3689	2.2978	2.2978	0.0597	0.0899	=0.2408	0.03645	0.3838	1.1883	0.44	=29.0694	0.7218
Net Reproductive Number	=0.30466	0.35468	0.04764	=0.0676	0.17868	0.00884	=0.002	=0.07438	=0.04886	0.08584	0.87382	0.0988	=1.4812	0.0884
Mean	152.38758	182 0.38 19	38.8, 6.092	89.80958	0.18782	0.00982	0.00982	0.04838	0.04838	0.08584	0.87382	0.0988	0.24645.8	0.08446
Standard Deviation	32.00884	0.1758, 0.1581	0.1, 0.1581	4.38888	0.00819	0.00819	0.00819	0.00819	0.00819	0.00819	0.00819	0.0819	0.0819	0.0819
Sum of Squares Between R_0		0.138	0.847	=0.818	=0.1616	0.048	0.599	0.1616	0.1616	0.818	0.847	0.758	=0.538	0.818
Residual Sum of Squares		=0.0484	0.1468	0.0835	0.0888	0.1178	0.1884	=0.0848	=0.0848	0.1758	0.1468	0.0758	0.1758	0.1468
Chi-Square Statistic		0.0888	0.188	0.0888	0.1468	0.0888	0.0888	0.0888	0.0888	0.0888	0.1888	0.0888	0.0888	0.0888
Degrees of Freedom		0.44 88	0.1468	0.0888	0.1468	0.0888	0.0888	0.0888	0.0888	0.0888	0.1888	0.0888	0.0888	0.0888
Correlation Coefficient		0.0888	0.1888	0.0888	0.0888	0.0888	0.0888	0.0888	0.0888	0.0888	0.0888	0.0888	0.0888	0.0888
Null Hypothesis Rejected	0.0888													
Model Validation	0.0888													

TABLE 8

SUMMARY FOR B_0 REGRESSION ANALYSIS ON TARGET Y TEST
MARCH 4TH AT WALKER

	B_0	B_1	B_2	B_3	B_4	B_7	B_{11}	B_{12}	B_{13}	B_{14}	B_{15}	B_{16}	B_{17}	B_{18}	B_{23}	B_{24}	B_{25}	B_{26}	Constant
Return Coupler Specification		0.32904	0.10742	-0.02266	-0.15401	0.06731	-0.26934	0.04232	-0.61454	0.09405	-0.05348	0.19569	0.09441	-0.31112	0.19411	-0.14741	0.06751	0.00006	
Best Prediction Coefficient		0.09918	0.03319	-0.0242	-0.02379	0.00935	-0.08306	0.0129	-0.03739	0.02931	-0.01718	0.06136	0.02968	-0.09661	0.04135	-0.02342	0.02053	-0.00009	
Mean	0.00000	0.00000	0.00001	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	
Screening Deviations	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	
Simple Correct on B_0		0.350	0.153	-0.130	-0.730	0.460	-0.819	0.81	0.498	0.358	-0.8 1	0.584	0.818	-0.1 30	0 309	0.540	0 205		
Partial Correlation with B_0		0.6979	0.3844	-0.2788	-0.318	0.2035	-0 1496	0.4648	-0.5894	0.1277	-0.4833	0 4742	0.2955	-0.4439	0 2853	-0.2582	0.2185		
Cor lation of Partial Correlation		0.4885	0.2701	0.0760	0.1016	0.0611	0.1018	0.1065	0 0835	0.1163	0.0952	0 1031	0.0958	0.0818	0 1023	0.0912	0.0184		
Regression Weight		0.69833	0.14898	0.11899	0.12888	0.06 306	0 09483	0.09853	0 11884	0.05881	0.05836	0 0844	0.04 954	0.04951	0.04888	0.05 05			
Contribution Toward Variance		0.2661	0.0514	0.0139	0.0157	0.0036	0.0111	0.0096	0 0 1	0.0033	0.0018	0.0115	0.0045	0.0040	0.0024	0.0009	0.0005		
Multiple Correlation	0.8772																		
Total Variance	0.769																		

only about 2 per cent to the total variance associated with significant variables alone. For the analyses of effort and elasticity, the increase caused by adding non-significant variables was much higher.

In Table 30 the effect of the refinement of the gross regression equation to net is more noticeable than in the other transformations, particularly because of the large change in the constant term. Whereas the gross constant term was -36 35316, the net constant is 118.18586 after the transformation. The coefficients also underwent tremendous change in magnitude during the transformation. A comparison of the first two lines of the tables shows that most of the net coefficients are less than one twentieth as large as the corresponding net coefficients, and some are less than a hundredth as large. It is obvious that the elimination of interdependency between independent variables reveals an entirely different relationship between the dependant variable and the respective independent variables.

A review of the final lines in both Tables 30 and 31 impresses one with the lopsided strength of one variable. Certainly the financial support of each pupil related most strongly with the amount of funds each person has available, but other factors are also significant. In the standardized data analysis, Table 31, for example, other selected socioeconomic factors contribute 18.15 per cent of the variance, and 23.66 per cent is unexplained. Educational leaders must consider other factors than just the disposable income per capita, if they are to fruitfully plan strategies for increasing the support of our schools.

Test of equation transformations

Each of the several regression equations developed by multiple regression procedures has been transformed to a more refined equation,

which we have called "net" regression equations, since they eliminate the effects of independency between independent variables. The net equations show with more specificity the relationships between variables, but the refined models would be of little use if the transformation had materially impaired their accuracy of prediction.

Therefore, a sample test was conducted to compare the predictive accuracy of three of the net regression equations with that of their corresponding gross equations. For each equation tested, predicted values of the dependent variable were computed, first using the gross model, and then using the net. Each set of predictions was then correlated against the actual values of the dependent variable. The results of the test show as follows that there has been negligible change in predictive accuracy.

Regression Equation			Coefficient of Correlation Predicted vs. Actual Values	
Variable	Derived with t-test?	Table Reference	Gross Equation	Net Equation
E_5	yes	11	0.4453	0.4633
D_5	yes	22	0.4666	0.4659
D_5	no	25	0.2844	0.2822

Correction for size of sample

The tables in this report have shown no corrections to the computed values of multiple correlation and total variance simply because they are too small to be material to the results of the study. Ezekiel and Fox (1959 301) offer the following formula for making such corrections.

$$R^2_{1.23\cdots k} = 1 - (1 - R^2_{1.23\cdots k})\left(\frac{n-1}{n-m}\right)$$

where R is the coefficient of multiple correlation, n is the number of cases, and m represents the number of independent variables included in the multiple regression equation.

This correction formula was applied to the 1960 multiple correlations for each of the three dependent variables, both for raw data and for standardized Z scores. The amounts of correction are illustrated below.

Regression Analysis			Multiple Correlation		Total Variance	
Var.	Form of Data	Table Refer.	Uncorrected	Corrected	Uncorrected	Corrected
E_7	Raw	14	0.8689	0.8615	0.7550	0.7422
E_7	Std.	15	0.5048	0.4858	0.2549	0.2360
O_5	Raw	22	0.4308	0.4146	0.1856	0.1719
O_5	Std.	23	0.3334	0.3844	0.1548	0.1478
R_4	Raw	27	0.9110	0.9070	0.8299	0.8266
R_4	Std	28	0.8654	0.8578	0.7489	0.7360

Each value is reduced very slightly by this correction for sample size, but not enough to have any effect upon the conclusions drawn.

The direction of the correction in each case is toward a weaker relationship between the selected socioeconomic factors and the respective measures of school fiscal policy, thus tending to reinforce the conclusions that other types of variables should be investigated.

A variety of statistical and analytical approaches has been used in this chapter to investigate the five hypotheses. They started with the same data and techniques which were used in the original studies of Florida, Georgia, Kentucky, and Illinois, but then branched out into the use of transformed data, alternate tests of significance, and techniques

for refining regression equations. Different approaches did not always lead to the same results, but no one set of results can be considered exclusively right or wrong. An attempt was made to evaluate the advantages and disadvantages of each and to synthesize these evaluations into conclusions concerning the hypotheses. These conclusions are summarized in the following chapter.

CHAPTER IV

SUMMARY AND CONCLUSIONS

Purpose of the Study

The purpose of this study was to examine the relationship of selected socioeconomic factors to local patterns of school fiscal policy in Florida, Georgia, Kentucky, and Illinois. Historically many educational leaders have felt that factors such as these were among the chief determinants of school financial support. More recently, however, another category of determinants has been suspected--leadership-related variables, such as decision making processes, typology and value systems of the informal power structure, traits of influentials, leadership of the superintendents and other educational officials, etc.

Which category is effective and to what degree? The present study was designed to help answer that question. It has concentrated on examining the influences of the first group of variables, selected socioeconomic factors.

Selection of Sample and Variables

This study replicates in part the procedures used in the original studies of Florida, Georgia, Kentucky, and Illinois by Hopper, King, Adams, and Quick, which related a similar group of selected socioeconomic factors to three different measures of local school fiscal policy. Data were collected for 1950 and 1960, for all districts having 1960 populations of 20,000 or more. The measures of school fiscal policy were:

Measure	Description
Local school financial effort	Total local school revenue receipts divided by net effective buying income. Symbol E_5 is used for the 1949 through 1951 average; E_7, 1959 through 1961.
Elasticity of demand for education	Basically this is the percentage change in local school revenue per pupil divided by the percentage change in net effective buying income per capita. The exact formula is given in Chapter II. D_3 symbolizes the 1945 through 1954 average, D_5, 1953 through 1962.
Local school revenue receipts per pupil	Total local school revenue divided by number of pupils in average daily attendance.

Statistical Procedures

Consistency of effort and elasticity

Rankings of the districts by E_7 effort were compared to E_5 rankings, and changes in rank over the ten year period were analyzed to evaluate consistency. Elasticities D_5 and D_3 were similarly ranked and analyzed.

Relationship of financial effort to income responsiveness

Pearson r's were calculated for financial effort E_7 regressed against elasticity of demand D_5 to determine the extent to which response to change in personal income per capita varied with change in effort. A t-test was used to evaluate the significance of relationship. The computation was first performed using raw data, then using standardized Z values.

Multiple regression techniques

Each of the three measures of school fiscal policy was correlated against the 17 selected socioeconomic variables. Each correlation was

performed twice, using a different arrangement of data each time. (1) all raw, (2) all expressed as standardized Z values. Each arrangement had advantages and disadvantages with respect to retainage of dispersions and elimination of extraneous factors which might affect some states but not others. These were discussed in Chapter II.

Using the techniques of stepwise multiple regression the independent variable was selected at each step which had the highest partial correlation with the dependant variable. This caused the greatest possible error reduction in the analysis of variance, based upon sum of squares of deviation. Successive steps continued to enter new variables as long as any independent variable remained which had an F level as high as 0.001. At the completion of all steps, a summary table was printed showing the contribution of each variable toward total variance, sequence of entry of variables, F level required for entry, total multiple correlation, and total variance.

Significance test

Following a procedure used in the original studies, a t-test was used to determine significance. Step by step through the multiple regression, the coefficient of each included variable was compared with its standard error, until one variable failed to equal the involved correlation's t-value multiplied by such standard error. The previous step of the computation was then accepted as final, all variables not included there being considered non-significant.

Because the application of this test appeared in some cases to eliminate unreasonable amounts of variance, summary analyses were made both with and without the use of the t-test, and results were compared.

Refinement of regression equations

Each multiple correlation step provided a regression equation to show the relationship of the dependent variable to each independent variable at that time. Each coefficient is expected to show the number of unit variations in the dependent variable which result from one unit of variation in the related independent variable. Celia (1967) points out that equations resulting from multiple correlation fail to do this, since each coefficient reflects not only the variance, associated with the independent variable itself but also additional variance indirectly attributable to other independent variables interacting with the independent variable.

Because of the inclusion of this indirect element, Celia (1967) refers to such unrefined regression equations as gross equations, and the coefficients as gross coefficients. He and others (Frisch, 1934, Wald, 1953, Ferber, 1962) have suggested methods of transforming gross equations to net, by using a system of weightings. The method suggested by Celia was used in this study to refine each of the regression equations produced; it required the computation of partial correlations for all independent variables, which were used as bases for computing weightings. The details of this method were presented in Chapter II.

Implications of the Findings

Hypothesis 1. Most school districts follow consistent patterns of financial effort and elasticity, yet some make marked changes in relatively short periods of time.

Effort --The hypothesis was supported with respect to financial effort. There was a strong tendency for internal consistency, with high effort districts tending to remain high and low effort districts disposed

to remain low. However, a few districts made marked changes in rank. These were the districts in which educators should have the greatest interest, for they demonstrate that change in fiscal policy not only can but has been made. Perhaps these districts can provide us with clues as to what factors are effective in overcoming the inertia which prevents desirable change.

Elasticity --The hypothesis was refuted. Forty of the 122 districts changed by more than 50 per cent of the full range of rankings, and six changed by more than 100 levels of rank. Not only was there a general reshuffling of relative positions, but the state means were scrambled, almost reversing their initial order.

The contrast between the consistency of effort and the inconsistency of elasticity was striking. The latter was obviously much more sensitive to changes in personal income and educational revenues than was the former. An illustration given in Chapter II demonstrates how this sensitivity can be associated with a wildly fluctuating coefficient of elasticity and yet effort remaining stable. Glazer (1959) pointed out that elasticity is a measure of sensitivity of change in revenue per pupil to change in disposable income per capita, and it is valid only for very small changes in the latter. This researcher questions whether the elasticity coefficient is not too sensitive for evaluating relationships of socioeconomic variables over a time span of ten years.

Hypothesis 2. High effort districts are more responsive to changes in per capita personal income than are low effort districts, such that they invest in education a greater portion of increases in their personal income.

There was no recognizable association between level of effort and fiscal response to income change. The hypothesis was emphatically denied.

Using raw data, a simple correlation of effort E_7 to elasticity D_5 yielded a correlation of only 0.00516. Even using standardized data, the simple correlation was only 0.2501, a variance of less than 7 per cent being accounted for. The above remarks regarding the oversensitivity of the elasticity coefficient are again applicable here.

Hypothesis 3. There is little association between socioeconomic factors and local school financial effort to support public schools.

The marked stratification of effort levels between states has been pointed out in Chapter II, particularly by Table 9, which shows the Illinois districts filling the top ranks of effort, and Georgia, the lowest. When the effect of this stratification was eliminated by the transformation of data to standardized Z values, it had a strong impact on the correlation of socioeconomic variables against financial effort. Using 1960 variables, for example, the raw data correlation accounted for 75.50 per cent of the total variance in effort, whereas the correlation based on Z values accounted for only 25.49 per cent. The conclusion regarding the third hypothesis obviously hinges strongly upon the relative merits of using the two different forms of data. This researcher accepts Guilford's conclusion (1965) that standard-score scales provide us with more comparable data than do raw score scales, so more emphasis is placed on the results using Z values.

The fact that the standardized data regression finds only 25.49 per cent of the total variance in effort accounted for by variation in the selected socioeconomic variables is a confirmation of the third hypothesis. For 1950 variables, the result was similar, with 28.82 per cent accounted for. This contrasts with the 1950 raw data reflection of 40.51 per cent.

Four variables were significant in 1960 using standardized Z values, seven using raw data. Three of these were common X_3, ADA as a percentage of total population, X_{19}, per cent of population comprised of 65-or more year-olds, and X_{22}, per cent increase in population over the last decade. The zero order correlations of these factors with financial effort E_7 are positive in each case, both for raw data and standardized Z values. There is little educational administrators can do to change such factors as these. It is fortunate that they account for only a small portion of the total variation in school financial effort. There is a strong implication that educators should investigate the effectiveness of other types of variables as determinants of school fiscal policy, and it is suggested that leadership related variables offer a fertile possibility.

Hypothesis 4: There is little association between socioeconomic factors and elasticity of demand for education.

No material amount of stratification between states was observed under the analysis for consistency of elasticity, and no material difference exists in the results of multiple regressions using raw and standardized data. The 1950 analyses account for 4.97 and 4.34 per cent of total variance, respectively. The 1960 analyses account of 15.48 and 18.56 per cent. In all cases, a weak relationship between variables was found, confirming the fourth hypothesis. Furthermore, the variables found to be significant by raw data analysis were different from these found significant in the Z value analysis. No variable found as significant in the 1960 analysis was also significant in 1950. These findings emphasize the inconsistency of elasticity of demand, which this researcher feels if the result of its over sensitivity for the purposes of this study. Similar inconsistency was found in the previous studies. In Florida, no significant factor was found in either of the two decennial years.

Hypothesis 5. Local financial support per pupil is significantly related to personal income per capita but not to other socioeconomic variables.

Both the raw data and standardized Z value analyses confirmed the first part of this hypothesis, for in both cases, per capita net effective buying income accounted for the bulk of the total variance accounted for. Only two other variables contributed as much as 2 per cent to the total variance. X_5, state revenue receipts per pupil, which was significant only in illinois of the original studies, had a negative influence upon local revenue receipts per pupil, contributing 4.07 of the total variance in the Z value analysis. X_{19} was significant only in Georgia, but the strong effect there carried over into both composite analyses, contributing 5.64 per cent of total variance in the raw data analysis, 7.67 in the standardized data. Both were positive influences upon financial support per pupil, caused by a high proportion of 65-year-olds in the population, particularly in Florida.

Although the existence of significant variables other than personal income per capita contradicts hypothesis 5, their effect is so small and so pertinent to isolated special situations that the hypothesis is felt to be substantially confirmed. But even with personal income per capita providing the principal influence upon school support, there is still room for considerable impact from other types of factors. The Z value analysis leaves 25.11 per cent of the total variance unexplained, and even the raw data regression fails to account for 17.01 per cent. The investigation of other categories of determinants is still warranted--categories such as leadership-related variables previously discussed.

General comments

Effect of significance tests --This study has shown at several points that the use of the 0.05 significance test caused intolerable errors. The multiple correlation accounted for up to 72 per cent more total variance than was acknowledged with the use of the t-test. More preferable methods of eliminating the lesser influential variables were recommended in the body of the report. The extent to which the accuracy of the original studies was affected by the use of the t-test cannot be determined without recomputing the multiple correlations. Because of this, uncertainty the findings of these studies are open to serious questioning.

Effect of interdependency between independent variables.--Twenty-one summary analyses of regressions were included in this report, and each of them presents a refinement of the regression model generated by the multiple regression program. The principal use of the regression equation in this study is to show the relationship between the dependent variables and the respective independent variables. The unrefined equation fails to do this, since each coefficient shows not only the direct effect of its own variable but includes also an element of indirect effect caused by other independent variables acting through interdependence with that variable. In eliminating the indirect element, the refinement changes drastically the sizes of the coefficients. The unrefined, or "gross," equations are very misleading. This researcher wonders what results might have been obtained in the original studies if the gross regression equation had been transformed to net equation.

Effect of using larger sample --The larger sample in this study as compared to the smaller samples used in the original studies of Florida, Georgia, Kentucky, and Illinois generated surprising results on several

occasions. Variables were found to be significant in the composite where they had not been significant in any of the smaller sample studies. On the other hand, variables which had been strongly significant in two or three of the individual states were non-significant in the composite. The results from the current composite study contrast sharply with those of the four separate studies. This emphasizes the need for the present study, which has provided a wider variety of influences and a more adequate sample size.

Conclusion

Because the quality of instruction is strongly related to the financial support of education, educational leaders must find a way of increasing that support. They must be aware of every resource available to them in bringing about this change. Already, school administrators spend great amounts of time and energy trying to shape the school fiscal policies of their districts. But until they know which factors are influential and to what degree, a large part of their energy will be wasted.

This study has examined the traditional category of socioeconomic determinants in a composite four-state area, and it has found a weak relationship between them and local school financial effort--the willingness of the people to support education, regardless of fiscal ability. The major portion of the variance in effort could not be explained by the studied socioeconomic factors.

An even weaker relationship was evidenced between these factors and elasticity of demand for education--the responsiveness of the people toward the needs of education when the average personal income changes. If this responsiveness is not brought about by socioeconomic factors, surely we need to find out what does bring it about.

The third area where the relationship of socioeconomic variables was examined was in their relationship to local school revenue per pupil. As expected, the disposable income per capita was found to be strongly related, but no other socioeconomic factor was influential. Furthermore, the standardized data analysis showed more than one-fourth (25 11 per cent) of the total variance unexplained. This leaves a wide area in which educational leaders need guidance as they attempt to plan strategies for improvement.

The extreme variance in the effort exerted by the different districts in the composite sample attests to the fact that some people become far more willing to pay for superior education than do others. The effort level in some districts was over fifteen times as high as that in others. What caused this drastic difference in attitude? We have not been able to adequately answer this question by examining the relationship of socioeconomic variables to school fiscal policy. It is suggested that leadership-related variables, such as those described by Presthus (1964), Kimbrough (1964), and others, offer a fertile field of additional possibilities. Statistical studies of the relationship of these variables to school fiscal policy are strongly recommended.

APPENDICES

APPENDIX A

TABLE 32

SUMMARY OF SYMBOLS

Dependent Variables

E_7 Financial effort for 1959 through 1961

E_5 Financial effort for 1949 through 1951

D_5 Elasticity of demand for education 1945 through 1954

D_3 Elasticity of demand for education 1953 through 1962

R_4 Local revenue receipts per pupil in 1950

Independent Variables

X_1 Average daily attendance in public schools

X_2 Per capita net effective buying income (in dollars)

X_3 Average daily attendance as a per cent of total population

X_5 State revenue receipts per pupil (in dollars)

X_6 Per cent of civilian labor force employment

X_7 Per cent of families with income of $10,000 or more

X_8 Per cent of population that is non-white

X_{12} Per cent of 14-17 year-olds attending public or private schools

X_{13} Median school years completed by 25-or-more year-olds

X_{14} Per cent of 14-or-more year-old females in labor force

X_{15} Per cent of employed persons engaged in manufacturing

X_{16} Per cent of population comprised of 25-or-more year-olds with 4 years of college education

X_{17} Median family income (in dollars)

TABLE 32 (Continued)

X_{18} Per cent of married couples not owning homes

X_{19} Per cent of population comprised of 65-or-more year-olds

X_{21} Population of the district (persons)

X_{22} Per cent increase in population over the past decade

APPENDIX B

DATA 77

RAW DATA FOR DEPENDENT AND INDEPENDENT VARIABLES
FLORIDA, 1980

Electrics	FIPS Code	Dependent Variables			Independent Variables																
		Y_1	Y_2	Y_3	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8	X_9	X_{10}	X_{11}	X_{12}	X_{13}	X_{14}	X_{15}	X_{16}	X_{17}	X_{18}	X_{19}	X_{20}
Alachua	101	1 503	0 96	113 0	10 781	7,443	82 28	610 90	0 0	11 0	26 0	65.8	11 0	29 0	0 1	7 0	0 03)	2.0	0.7	34 024	23 0
Bay	105	0 975	0 24	67.6	24 405	7 093	71 96	305 30	0 1	5.1	10 0	65.7	11 1	31 0	10 7	7 0	0 010	1 0	7 1	90 101	07 3
Broward	103	1 598	0.87	110.8	25,481	7,427	71.87	150.64	0 1	10.0	11.2	81 0	12 1	34.0	26 0	5 0	6,123	0 0	5.7	1 035	771.1
Brevard	104	0 222	1 86	240.0	60 781	1 279	18.83	170 62	9.5	10 0	10 0	89 0	11 0	33 0	10.7	7 0	0 098	1 0	71 0	877 966	287 0
Columbia	05	1 768	0 10	0.0	4 348	1 207	77 89	399 79	0 0	0.1	38 0	97 0	07 0	17 0	0 9	7 0	7 467	1 0	8.7	20 072	10 0
Dade	106	0 011	0 79	264 6	157 407	7 200	6.85	60 02	0 0	16.9	10 0	88.0	11 0	36.4	11 0	6.1	8,348	0.7	10.0	937 647	88 0
Duval	87	1 495	0 83	96.0	54,871	7 810	30 85	172 89	4.4	12.0	23 0	88.4	10 0	30.1	10.1	6 0	7 345	2.0	6.2	877 011	49 0
Escambia	106	1 220	1 86	104.6	34,434	1 651	80 05	154 11	9.3	10.4	20.3	89.1	10 0	29.6	80 0	6 0	7 134	0 0	7 3	773 819	54 2
Gadsden	105	1 434	0 89	54 0	9 691	986	20 85	226 10	0 0	6.0	50.4	0% 0	7 9	39 0	11 0	1 0	7 098	0 0	9.0	01 989	10 0
8 Islands	110	0 891	1 03	147.0	0 682	1 491	71.88	704.87	4.3	6.0	81.2	98.0	0 0	81.1	0 0	3.0	7 735	2.0	10 1	01 538	56 0
Ft Lauderdale	111	1 580	0.21	131.6	74,672	1 827	10 72	182.10	5.0	0 7	10 0	88 0	10 1	30.0	10.5	6 0	0 010	0 0	0 0	357 788	95.2
Indian River	110	1 04	0 97	102 8	7 940	1 661	19.96	101 7	4.8	6.0	81 0	89 7	10.8	87 4	9 0	0 0	0 010	1 0	17 0	25 569	113.7
Jackson	110	0 764	0.41	87 5	8,098	938	84 44	239 0	5.8	4.7	81 0	96 1	0.6	30 0	11 0	2.0	7 864	1 0	0 0	00 736	4.7
Lake	110	1 907	1 34	137 0	1,446	1 458	10 96	105.73	0 2	0 0	10 0	86.0	10 1	28.0	9.8	4.0	7 681	1 0	0 0	07 363	97.0
Lee	110	1 147	0 17	150.8	10,490	1 982	10 72	188 79	4.1	0 0	10 0	81.4	10 0	33.4	0 0	0 0	7 180	0 7	10 0	56 539	135.0
Leon	110	1 150	1 71	90.0	11,062	1 434	20.20	288.94	3.8	10 0	30 0	88.0	11 0	44.0	6.7	0 0	0 173	2.0	0 0	76 777	43.6
Manatee	110	0 857	2.10	101 0	17 033	1 454	10 56	160.33	4.1	6.6	10 7	87 7	10.1	29.1	11 7	4.0	0 014	1 0	10.0	60 168	89.7
Marion	110	1 566	0 68	89.7	77 951	1 265	23.21	011 80	4.8	6.8	84.3	90 0	0.5	36.1	10.5	0 0	7,573	0 0	10 0	01 0 0	89 2
Monroe	110	1 556	1.82	304.2	6,818	1 908	10 38	205 79	4.9	0 7	10.4	72 0	10 9	01 0	4.4	7 0	0 060	2.0	0 0	00 881	60 0
Okaloosa	120	0 946	0 72	30.9	17 139	1 527	10 96	010 70	5.4	12.7	0 0	96 0	12 1	20.9	15.4	4.1	0 901	1 0	3.1	01 175	137 0
Orange	101	1 076	1 24	148.3	53 276	1 797	10 49	176.96	5.0	10.0	15.5	87.4	11.9	35.8	10.8	6.7	1 982	2.0	6.4	243 900	178.7
Palm Beach	120	1 765	1 96	100.4	44,438	098	17 88	160 79	4.8	12.7	88.9	87 7	11.3	38.0	0 1	0 0	0 784	0 0	12 0	2318 166	98.0
Pasco	123	1 090	1 30	138.7	0 017	1 010	17 64	207 01	0.4	0.4	11 1	89 0	0.9	26 1	10 0	0 0	7 340	1 0	10 0	56 785	79.7
Pinellas	124	1 643	1 42	010 7	96,440	990	17 05	180 87	0 7	10 0	0 0	87 0	11 1	07 0	11 0	5.5	0 959	2.0	0% 0	0% 866	115 7
Polk	125	1 950	1 23	104 0	01 011	1 586	21 32	183.96	0 0	10.1	10.0	0% 0	0 0	37 0	10 0	3.0	0 076	2.0	10.2	795 179	57 0
Putnam	126	0 016	0 68	130 0	0,643	1 070	77 70	304.10	0.5	0.1	01 1	80.0	9 4	30 0	22.7	2.0	7,959	2.1	0.5	30.7 7	36.0
St Johns	127	1 233	1 56	137.7	5,611	1 441	70.01	187 30	0.7	0 0	07.4	90 0	10.5	30 6	0 0	0 0	0 169	2.0	11 0	30 034	80 1
St Lucie	128	1 801	0 39	137 0	0 970	1 511	02 26	101 37	0.4	0 0	26 0	89 0	10 0	51 0	7 0	0 0	0 011	0 0	10 4	39 934	94 7
Santa Rosa	129	1 004	1 53	00 0	0 125	1 129	00 74	201 10	0 0	0 1	0 0	0% 0	10.2	07 0	00 0	5.0	0 691	1 0	0 0	20 947	59.0
Sarasota	30	0 440	0 30	0% 0	10,869	7 093	0.70	196 57	4.3	10 0	5.0	97 0	11.6	39 1	9.5	6.0	0 090	1 0	10 4	76 805	166.0
Seminole	131	1 398	0.44	97.3	71,404	5,393	86 79	193.66	0.4	8.0	36 0	88 0	11 0	30 0	11.4	0 0	0 446	0 1	0 0	54 940	194 0
Volusia	30	1 588	0 01	145 0	28,385	7,693	18.01	201 68	0 7	0 7	10 0	80 0	11 0	01 0	0 3	0 0	0 114	1 0	10 0	125 170	68.0

TABLE 34

RAW DATA FOR EXPERIMENT AND ANCILLARY VARIABLES
30 MAR 84 1800

Districts	Dist.	Experimental Variables			Ancillary Variables														
		x_1	x_2	x_3	x_4	x_5	x_6	x_7	x_8	x_9	x_{10}	x_{11}	x_{12}	x_{13}	x_{14}	x_{15}	x_{16}	x_{17}	x_{18}	x_{19}	x_{20}	x_{21}	x_{22}
Ba dain	201	5.661	4 33	38.4	4 716	1 158	13 84	159.31	4 4	4 9	39.4	36.6	4 4	38 0	19.1	4 4	4 333	4 4	4 333	34 166	4 7
Alba	202	8.377	1 95	63 1	30 32	1 586	21 24	132 46	4 4	1 6 1	33 4	88 3	3.7	42.4	80.4	4 4	4 428	4 4	4.0	101 364	33 0
Bailack	203	4 838	4 91	20.0	4 886	1 005	22.23	418.06	4 4	8.3	36.4	88.	8.4	33.4	17 4	3.2	4 886	2.4	6.8	24 263	1 4
Burke	206	5.881	4 62	34 4	4 716	360	34 88	135 63	4 4	4.4	66 4	88.3	8.4	33.0	16.2	1 4	1 583	4 4	4 4	34.586	-13 4
Carroll	209	0.633	1 99	70.0	4 886	1 113	13.46	200.14	4 4	5.8	34 4	89 3	8.4	34 4	43.4	1 4	4 513	3 4	3.5	28.478	-3 4
Calumet	210	4 338	1.36	33 4	4 372	1 199	38 51	172 13	3 4	4.8	1	89.7	8.0	38.8	44.4	1 4	4 886	4 4	6.4	31 164	33 3
Chatham	204	1 189	1 77	98.1	30 833	1 629	13 34	143 63	4.4	10.5	34 1	88 3	10.4	33 4	22.8	3 8	4 363	3 4	4 4	186.289	34 4
Champaign	208	0.638	1 58	82.4	4 886	1 00	44.88	167 38	3 4	5.1	4 4	88.2	4 6	43.0	43.6	1 4	3 886	4 4	4 4	41.881	10.8
4 Ayres	209	1 330	4 30	118 4	3 504	1 560	14 48	141 43	3 4	11 3	35.4	88.8	10.4	48.4	82.2	3 4	4 443	2.4	7.8	45 383	34 1
4 Clayton	415	5.833	4.73	38.2	11 188	1 691	34.88	139.02	4 4	10.8	16.4	86.2	10.4	33 1	28.4	4 4	4 391	3 4	4 4	46.365	100 3
Cobb	411	4 952	1 72	34 4	20 304	1 483	33.41	148.88	4.8	10.3	4 4	85.3	10.3	35.1	37.2	4 4	1 4	2.4	4 4	88.289	116.4
Heiland	414	4 200	1 81	73 4	4 886	1 796	28 37	119.11	4.8	18.1	4 4	88 4	31 6	42.4	31 4	4.8	4 877	2.1	4 1	33 886	33 8
Coffee	416	8.886	1.88	38.8	5.488	1 944	34.00	186.88	4 4	4.3	4.3	89 4	4 4	41 4	14 4	4.8	4 700	2.4	4 4	41 915	-8.4
Decatur	418	4 724	4.82	33.8	5.698	1 3 3	32.58	138.88	4 4	4.8	41 4	88.4	8.4	43.4	14 3	4.2	3.888	8.1	4 4	35.788	8.3
Dewalt	413	1 888	4 33	131.4	41.866	4.433	14 38	120 73	4 4	41 4	4 4	88 6	13 1	38.1	38.8	4 4	3 138	2 4	3 4	138.758	100.4
Douglas Effy	415	1 185	4 61	131.1	3.866	2.4 3	7.58	113.66	4.4	34.3	4.4	89 4	8.1	40.4	13.3	8.4	4 668	2.4	1 4	33 816	1 4
Dougherty	414	8 836	4.93	47 4	16.888	1 888	22.88	163.38	4 4	9.4	34 4	88.2	23 4	40.4	18.4	3 4	4 48	2.4	4 4	15 888	73 3
Floyd	414	366	1.21	88.8	4 188	1 186	29.51	142 14	4 4	11 8	3 4	88 4	8.4	35 4	43.4	3 4	3 357	2.4	4 3	38.866	12.3
Fond Elle	416	1 054	4 3	88 4	4 885	1 693	38.88	188.87	4 4	8.3	22.4	88.8	9.8	42.4	88.4	3 3	4 585	2.4	4 3	12 886	8.8
Kalamazoo City	420	4 414	4 66	134 3	88 192	2.886	14 29	87 88	4.3	15.4	34 4	84.8	10.5	43.4	14 2	3 4	3 829	3.4	3.8	487 466	66 1
Glynn	221	4 822	1.88	114 4	4 886	1 873	31.20	163 15	4 4	9.3	33 4	87 4	10.3	41 4	28.4	3 4	4 792	4 4	3.4	4.388	98.4
Spalding	886	4 864	1 66	88 3	4 786	1 878	41.88	151 84	4.2	8.4	28.4	88.7	8.3	38 4	48.8	4 4	4 888	3.4	3 4	35.488	14.4
Hahnemann	213	8 878	3 34	34 4	4 188	1 33	23 27	166.83	4 4	8.6	4 4	84 3	8 3	32 4	37 3	1 4	4 61	4 4	6.8	38 333	58.1
Hall	218	4.388	2.38	88 4	4 378	1 888	34 38	169.88	4 4	3.4	4.4	88 4	4 4	33 8	48.8	1 4	3 888	3 4	3 4	33.888	14 8
Houston	235	4 956	4 81	88 4	5.688	1.488	38.14	163 83	4.8	16 3	38.4	88.3	34.5	32.4	4.3	3 4	5.552	3.4	3.2	38.138	86.4
Lafarange	228	1 888	3 34	88 4	1 848	1 848	23 32	83 66	4.1	4 4	34 4	85.4	8.3	38.4	42.4	1 4	4 358	3.4	4.8	43.438	-5.8
Muscogee	227	1 78	4 34	98.1	32 638	1 888	34 38	118.51	4.4	8.3	34 4	88 4	13.4	34 4	28.4	3.4	4 981	2.3	4 4	138.883	38.4
Newton	224	1.714	1 85	37 1	4.488	1 333	21.38	176.41	4.2	4.9	34 4	81 4	8.1	42.8	41 4	3 1	3.888	3.4	2.4	39.888	4.4
Richmond	229	1 127	1.16	98 3	88.884	1 888	38 38	148 61	4 4	8.3	31 4	88 4	9.3	38.4	28.8	3.4	4 288	3.4	6.3	138 888	38 3
T ft	238	1 14	98 4	5.883	1 1 8	33 38	138.95	4 4	4 4	29.4	88 4	8.3	47.4	18.8	3 8	3 258	3 3	4 4	25.883	3.3
Valdosta	237	2 853	4.36	34 3	4 188	1 848	38.88	14 87	4.2	10.8	36.1	85.4	10.4	41 4	18.4	4 4	4 368	2.3	4.4	38 888	58 4
Walker	212	4 872	4 87	88 4	4 188	1 838	31 88	157 38	4.3	8.3	4 4	89 3	8.3	38.4	58.3	1 4	4 564	3.4	3 4	45 388	18.3
White oak	886	4 383	4.38	88.8	5.678	1 188	38 58	188 88	4 4	8.8	4 5	38 4	4 4	37 4	38.4	4 8	4 238	3.4	6.4	38 48.1	31 3

TABLE 39

RAW DATA FOR DEPENDENT AND INDEPENDENT VARIABLES
KENTUCKY 1980

Alt. Index	Block Code	Dependent Variables z_1	z_5	θ_1	Independent Variables x_1	x_2	x_3	x_4	x_5	x_6	x_7	x_8	x_{12}	x_{13}	x_{14}	x_{15}	x_{16}	x_{17}	x_{18}	x_{19}	x_{21}	x_{22}
Boone	301	1 784	0 12	131 8	2 956	1 344	15.30	108 15	2 2	11 2	6.2	89 6	0.8	25 8	24 1	2 2	0 794	2 2	2 2	20 418	68.6
Ashland	302	1 269	1 37	168.6	2 852	1 791	16.72	121 30	2 2	11 9	2.2	94 2	12 6	29.1	33 2	2 6	2 482	2 2	2 2	3 283	0 0
Campbell	303	1.320	1 02	16 2	2.274	1.778	13 68	103 93	4 0	12 2	1 0	86 5	6 1	21 8	32 2	2 0	0 332	1 0	10 2	33 451	12 6
Hammers	304	1.428	0.92	184.8	2 565	2 266	11 85	126 44	6.2	8.3	3 0	78.0	8 0	34 6	35.7	6 6	0.884	2.8	18 2	30 838	2 1
Carlo	305	1.286	1.08	3	4 020	506	92 24	197 27	22 8	2 2	0 1	75 2	0.2	10.6	33.3	1 1	2,952	2 6	9.2	29 812	2 2
Christian	306	0.6 8	+0 52	78 4	4 460	1,649	11 91	198 20	4 2	3 2	22.6	72.2	3 0	22.8	22 8	2 8	2 740	2 2	8 6	37 439	16 2
Clay	307	2 842	0 86	20 6	2 132	216	20 84	210 98	72 1	3 3	2 3	65.2	3 0	11 2	2 3	0 6	1 882	0 6	8.6	35,368	-10 2
Daltons	308	2 273	1 02	139.6	4 960	1 180	13 43	193 18	6 1	5 2	6.4	85.0	6 2	36.2	31 0	3 6	6 780	1 2	8 0	28 112	25.3
Owensboro	309	1 423	1 70	188.5	8 229	566	18 67	258 69	6.0	11 8	8 2	38 8	10 0	33 9	33 2	3 6	5 878	1 2	8 8	42 431	26 6
Fayette	310	2 185	6 37	198 9	12 222	683	19.28	149 85	8.5	13 2	13 2	82 8	21 0	38 2	18 2	6 8	5 822	2 8	8 6	69 986	30 9
Lexington	311	1 491	6 34	202 3	8 938	1 642	12 12	118 59	6.1	2 8	25.0	79 8	2 8	81 2	12 2	5 0	3,999	2 8	21 2	62 810	12 1
Floyd	312	1 438	2.48	96.6	11 818	940	27 69	287 28	13 4	3 6	6 8	75.8	0 8	13 2	3.2	8 6	3 802	2 6	3 8	8 642	-23 2
Greenup	313	1 318	1.24	86 2	2 780	-218	17.83	158.31	8.5	2 2	0.2	84.0	8.8	12 2	28.0	1 5	0 533	2 2	3 2	25 825	12 2
Hardin	314	0 874	+0 62	69 1	8 215	1 805	9.96	173.28	6.6	3 2	3.6	56.5	10.1	26 1	8.2	1 8	3 869	1 6	4.1	56 148	9 2
Harlan	315	2 382	6 12	29 6	10 542	1 583	22 46	218 00	11.5	3 2	2 8	82 8	0 0	12 2	5.4	1 8	3 876	2 2	3 2	83 930	-28.6
Hopkins	316	1 581	1 16	112 2	6 867	1 264	2 82	194 81	3.0	2 8	8 8	82 2	8 8	23 6	8 2	1 4	4 844	2 2	12 2	32 279	-0 6
Jefferson	317	2.381	0.27	221 8	48 502	8 803	22 12	146 84	2 2	10 8	12 2	83 2	6 2	26 8	21 8	2 6	3 796	2 2	8 2	212 138	20 8
Louisville	318	1 431	0.49	254 6	43 266	1 419	11 32	189.88	6.2	11 9	10.8	81 2	8 2	39 6	69 2	2 2	8 780	2 8	10 2	190 838	2 6
Kenton	319	1 342	0.83	176.2	5.622	1 834	11 98	139.38	3.6	12 2	3.2	84.9	8 4	32 2	42.0	2.2	8 818	1 6	5 2	82 818	12 8
Lovington	320	1 386	0.65	212 8	3 122	1 865	11 00	118 10	4.4	3 2	5.8	73.2	8 2	36.6	29.0	1 7	3 302	1.6	8.2	66 278	-6.2
Knox	321	0 624	+0.14	80 1	5 954	844	23 98	238 84	9.4	1 2	1 2	74.1	0.1	16.8	13.2	1 5	1 722	2 2	9.2	22 862	-16.4
Letcher	322	1 116	0.12	33 2	3 815	925	08 23	177 33	8.4	8 2	2 4	88 6	0 0	13.8	2 2	0.2	3 219	2 8	3 2	22 906	-22.8
McCracken	323	1 202	0.61	96.6	6 812	1 338	21 88	187 88	6 8	9.2	10 2	86.4	6 6	21 2	29 8	2.8	8,316	8.8	12 2	22 882	16.6
Peduoah	324	1 338	0.36	105 8	8 005	691	12.42	153.80	3 1	9.6	10 2	86 6	8 2	34 2	80 6	3.5	4 750	2 2	12 2	34 871	8.6
Muhlenberg	325	1 581	0.77	21 2	6 653	1 007	22 26	177 00	9.2	2 2	4.8	76 2	6.2	19.1	12.2	1.6	3 352	2 1	12.2	20 880	14 5
Perry	326	0 822	+0.81	33 6	3 498	836	22 84	182 60	6.8	2 2	3.8	78.2	8.8	16.8	9.8	1 2	2 689	1.8	8 2	18 883	-34 8
Pike	327	1 183	0.48	96.6	12 822	618	28.81	182 38	14 9	3 1	8 8	82 8	8 1	13.2	5.2	1 1	2 802	3.1	8.8	63 218	-12 8
Pulaski	328	1 853	0.48	85 8	8 826	875	18.34	228.63	6.5	3 2	1 8	74 8	8 2	21.8	18 1	1 3	8 781	2 2	10 6	26 822	10 2
Bowling Green	329	0 986	0 68	111 6	3,312	2 928	11.68	146 11	5.2	9.2	11 8	81 4	2 6	38.2	16 8	4.9	8 106	3.6	13 6	18 838	14.5

RAW DATA FOR DEPENDENT AND INDEPENDENT VARIABLES
ILLINOIS 1960

Districts	Dist. Code	Dependent Variables Y_3	Y_5	Y_4	Independent Variables X_1	X_2	X_3	X_5	X_6	X_7	X_8	X_{10}	X_{16}	X_{14}	X_{15}	X_6	X_{16}	X_{18}	X_{19}	X_{21}	X_{28}
Alton	481	3 595	0 30	657 3	4 633	8 152	63 35	128.00	4 9	16.4	11 6	69 6	10 0	36.6	62 1	6.4	4 453	1 6	10 4	46 046	68 6
Aurora East	482	3.218	1 76	618 6	6 584	8.166	18 86	97 80	8 8	81 4	3 6	89 6	11 2	41 8	41 6	7 6	6 084	8 6	10.2	33 315	26 4
Aurora West	483	3 868	1 16	666 6	6 695	8 379	18.41	102.05	2.8	81.0	3.6	88.6	11 8	41.8	41.6	7.6	6 084	1 8	10 8	80 000	88 4
Belvidere	484	6.443	1 25	616 6	6 306	8 099	25 48	124.99	2.6	16 6	6 6	84 4	12 6	46 4	46 4	6 8	4 165	1 8	12 5	31 116	18 3
Bloomington	485	8 039	0 63	635 4	6 163	8.277	16 10	86.31	6 9	16 6	6 8	89 8	11 6	48 1	18 6	9.4	5.994	1 6	16 6	56 161	8 8
Champaign	486	3 789	0 46	564 4	7.483	8 388	16 06	98.46	3.6	20 8	4 4	61 1	10.4	40.8	8 6	88 1	4 591	1 1	4 4	49 583	25 6
Chicago	486	1 835	1 36	389 8	616.422	8 498	11 65	83 51	6 6	81 6	23 6	85 6	14 6	42 6	33 6	6 9	4 738	8 6	8.8	6 588 598	-1 4
Danville	488	8 672	0 35	281.8	6 616	8.181	20 86	153.72	4.9	16.4	11 0	82.6	10.6	43 6	39 1	6 6	5.818	1 4	14 8	41 866	10 5
Decatur	489	6 123	1 76	626 1	17 162	8 431	22 81	152 76	5.1	16 6	6 3	88 6	11 1	36.6	28 4	6 6	4 696	1 4	11 8	78 084	16 6
Dixon	614	3 729	1 16	646 6	6 616	8.040	16 96	88 44	6 6	16 4	6 8	63 8	8 8	38.6	33 6	6 4	4 336	8 8	10 6	8 565	69.8
East St Louis	611	3 833	-0 16	897 6	13 818	1 799	81 63	158.18	10.6	8.3	44 6	88 4	8.7	83 6	89 6	8 4	6 842	1 8	4 6	81 2	-0 6
Edwardsville	614	6 228	4 58	616.8	6 755	8 158	37 56	118.86	4 6	19.6	4 5	88 5	4 6	88 4	89 4	8 3	8 671	1 6	11 4	8 996	13 4
Elgin	616	6 118	0 96	673 6	18.284	8.116	88 88	88 88	8 4	41.4	6 6	87 6	10.5	36.8	37.1	6 4	6 166	1 8	16 6	49 446	11 8
Frankfort	614	3.660	4 76	688 8	6 185	8 066	18 46	123 36	6 6	16 8	4 8	81 1	11 8	43 4	42 6	6 4	4 287	1 6	16 6	24 628	18 5
Galesburg	615	3 818	1 81	351 6	6.895	8.035	17 61	116 78	3.6	16.1	4 6	81 6	11 6	35 4	33.5	6.6	4 838	1 6	16 8	63 246	18 5
Jacksonville	614	3.896	0 46	491 7	3 996	1 798	18.43	108 18	4 8	16 8	6 6	88 6	10 8	36.4	16 8	5.6	6 663	6 4	18 1	81 490	6 4
Kankakee	616	3 613	0 66	616 8	5 838	8 116	81 06	116 44	5 9	16.6	6 8	85 6	10 6	46.8	36 1	6 6	5 854	8 4	11 8	86 866	6 4
Mattoon	618	3 896	0 76	326 1	4 989	1 958	24 04	130.57	3.6	11 1	8 4	86 8	12.1	39.3	86.8	5.2	6 636	8.8	11 9	18 888	8 8
Moline	4 4	3 436	1 67	618 5	4 843	8.438	81 18	169 86	6 4	19.6	4 4	93 1	11 4	88 1	44 6	6 6	8 881	1 8	11 6	42 705	14 4
Peoria	428	1 788	2 88	623 6	16 394	8 388	14.88	45.18	4.8	16 6	6 6	84 1	11 5	66.4	38 8	6 1	5.881	1 8	11 6	88 162	6 4
Quincy	421	3.863	1 05	657 8	6 118	1.956	16 36	88 05	4 8	9.6	8 8	88 8	10 8	33 8	35 1	6 8	6 676	1 2	16 9	46 799	8 3
Rockford	428	8 378	1 68	611 1	38.288	8.464	16 68	86.86	3.3	18.8	4.3	86.6	11 8	39.6	44 4	6.7	4 856	1 6	15 6	36 706	88 4
Rock Island	431	8 558	1.87	635 4	8.163	8 278	16 67	126 58	4 4	18.4	5 6	88 4	18 6	36.8	37.6	7.6	8 688	8.6	18 4	61 886	6 5
Springfield	634	6 798	1 86	661.6	16 366	2.276	19.86	116.16	6 6	16 4	6 8	86 6	11 1	44.6	18 8	6.4	5 886	1 6	16 8	83 861	8 4
Urbana	426	1.427	1 05	328 8	4 616	8.469	15.44	138.68	3.4	18.8	6 6	88 6	18 8	39.1	6 4	88.2	6 388	8 6	8 4	37 396	16 6
Collinsville	624	4 438	8 72	188 4	4 628	1 898	32.55	194 61	4 4	16.1	8 3	94 6	4 8	62.8	61 8	6 6	4 885	1 4	18 1	16 816	14 4
Granite City	627	6 853	1 86	342 4	18 886	8 894	25.83	138.88	6 8	18.8	8.2	83.2	3.6	63.8	68 4	4.8	4 746	1 6	6 8	48 873	88 4
Marion	428	6 234	8 88	88 4	3 838	1 886	61 81	188.56	8 6	18.8	8 4	88.8	4 4	61 8	19.4	5.8	6 184	1 6	16 1	11 826	3 8

RAW DATA FOR DEPENDENT AND INDEPENDENT VARIABLES
ILLINOIS 1950

Counties	Dist	Dependent Variables		Independent Var ables															
		z_1	z_2	x_1	x_2	x_3	x_4	x_5	x_6	x_7	x_8	x_9	x_{10}	x_{11}	x_{12}	x_{13}	x_{14}	x_{15}	x_{21}	x_{22}
Alachua	101	1 39	0.41	5.381	1,049	18.20	140.88	0 5	1 5	29.0	81 0	10 0	03 0	2 5	4.0	1 210	2 0	8.1	82 820	40 3
Bay	102	0 363	1 01	0 972	1,901	18.01	5.90	1.0	1 1	16.8	63 1	9.0	86.3	23 9	2.0	0 336	0 5	0	01 689	106.0
Brevard	103	1 120	0.58	0 0 3	1,210	18.36	120 20	0 0	1 0	23 0	89.0	0.8	30.2	8.1	4.0	1 726	5.9	22 0	23 090	46.3
Broward	104	0 340	1 38	10 379	1 168	18.13	98 10	0 0	0 1	80 0	92 0	10.9	81 9	6.0	0 0	2 808	0 0	0	03 335	118.9
Calhoun	109	1 005	1.38	0 772	805	20 73	159 60	0 0	0 0	33 0	79.0	0.0	31 0	33 0	1 0	1 587	4 0	0	10 010	8.0
Dade	105	1 768	1.12	01.6%	1 386	12 03	92.67	9 9	4.3	33 2	86.9	12 0	33 9	0 9	4.9	0 806	8.1	0 9	499 386	81.9
Duval	107	1 800	0 88	45 210	1 282	14.30	66 01	0 0	0 0	86.9	82 0	8.9	36 0	13.0	3.0	0 805	9.6	5.0	394 006	44.7
Escambia	108	0 977	0 56	16,61 3	1,010	0 44	128.45	0 1	1 0	32 0	92 0	8.0	28.2	13.1	6.5	0 96	8.5	5.1	12.706	18.9
Gladsden	109	0 820	1 00	0 233	631	13 68	145 01	0 1	1 1	56.1	66 9	9.9	35 1	9.2	3.1	1 356	9.1	8.0	36 560	18.9
High ands	110	2.362	0.19	1 624	581	8.62	83 56	0.8	0 0	23 0	83 0	5.1	83.5	9.9	4.0	1 726	8.5	30.0	12 636	00 0
Gil sborough	111	1 362	0 79	37 365	2 182	0 94	72 70	0 0	1 9	3 0	83.1	8.0	33 0	16.1	2.9	0.0	0 0	8.1	248.894	36.1
Indian River	112	1 479	0.82	3 098	150	20 08	230 56	0 0	0 0	36 9	79.9	9.0	33.9	2 0	0 0	1 808	6.0	8.0	11 672	34.5
Jackson	113	5.36	0 54	0.890	628	22 22	148.54	0 0	0 0	03 0	81 0	9.9	32 0	8.3	2 0	1.082	5 0	0	34 665	8.0
Lake	114	1 293	0 34	0 634	172	13.25	101 00	1 1	1 0	32 9	82 0	9.0	29.1	9.3	4.3	1 538	8.5	11 3	36 340	31 3
Lee	116	1 802	0.39	0.066	362	13.33	98 56	0 1	0 0	20.1	86 0	10.6	31.0	6.1	4.0	1 727	9.9	5.9	03 805	31.9
Leon	110	0 783	1 03	9,165	1 4%	0 76	142.70	0 0	1 3	79.0	65 0	9.1	38.0	0 1	5.9	1.423	0 0	9.0	01 950	01.0
Manatee	117	1 20	0.46	6.018	552	1 33	36.50	0 0	0 0	22 0	92 0	9.0	33 0	9.9	2.9	1 396	6.0	12.0	36 206	31.0
Marion	118	1.453	1.83	0 563	982	9.30	44.68	0 0	1 0	36 0	84.0	8.0	86.0	10 1	2 9	1 642	8.0	8.0	36 187	33.1
Monroe	119	1 788	0.40	3 972	652	9.92	138.52	1.2	1 0	10 0	77 0	10 0	18.5	3.0	5.1	1 776	9 9	4.5	03 890	113.9
Okaloosa	120	1 242	0 82	5 623	681	15 50	48 00	4.5	0 0	8 9	77 0	8.0	18.6	0 9	2.1	1 181	8.0	4.3	07 553	115.0
Orange	121	1.410	0 79	10,662	1 373	3 01	109 20	0 0	0 0	19.0	82 0	10 6	01 0	9.6	5.1	0 958	6.9	15.0	0 950	64.9
Palm Beach	122	1.491	0 20	10 804	1,225	0 20	93 05	0 0	3.3	36 3	91 1	8.9	40.0	4.1	4.3	1 810	6.9	9.0	110 806	09.4
Pasco	123	1 826	0.77	3.659	728	1.91	45 11	0 0	1 0	33 0	83 0	0.0	03.1	10.1	3 9	1 336	3.9	10 1	30 530	44.8
Pinellas	124	1 220	1 35	20,805	1,641	3 06	96.01	0 0	2 0	3 0	86.0	12.3	86.7	0.8	5.1	1 896	5.3	28.8	128.249	03.4
Polk	125	1 573	0 84	22 965	1,041	16.38	313 03	0 0	0 7	20 0	81 0	8.8	01.4	15.1	3.1	0 89	6.9	0	123 093	41 1
Putnam	126	1.431	1.09	0 481	1,055	18.09	104 20	0 3	1 2	36.5	80.0	8.0	33.4	01.8	0 0	1 491	0 9	9.4	33 010	24.3
St Johns	127	0 867	0.43	3.498	156	3.01	23 01	0 1	0.0	33 3	81 0	0.9	34.4	5.9	5.0	1 633	8.0	9.1	34 290	26 0
St. Lucie	128	1 350	-0.58	0 312	1,030	20 00	225 75	2 0	2.1	31 3	72 9	9.0	37 0	6.1	0 0	0 805	6.4	6.0	20 120	70.5
Santa Rosa	129	1 257	0 13	3 883	011	86.00	60 93	0 0	0 9	9.0	80 0	8 9	12.5	9.1	1 0	1.003	9.0	0 1	8.504	15.0
Sarasota	130	1 377	0 03	4.805	2 183	3.37	03 56	1 1	0 0	16.0	86.0	11 2	32.0	0 0	3.5	0 036	3.4	11 0	30 823	36 9
Seminole	131	1 806	-0.09	4.506	3,823	16.36	3 6.10	0 0	1.0	44 0	81 0	8.4	36.7	5.9	3.8	1 898	8.3	8.8	26.885	20 0
Volusia	132	1 813	-0 20	13 298	1,381	3 82	336 44	0 0	2 1	83 1	86.0	10.6	30.0	6.8	5.2	1 665	6.1	13 4	36 203	30.2

TABLE IV

RAW DATA FOR DEPENDENT AND INDEPENDENT VARIABLES
GEORGIA, 1950

Counties	Size	Dependent Variables		Independent Variables														
		Y_1	Y_2	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8	X_{11}	X_{12}	X_{13}	X_{14}	X_{15}	X_{16}	X_{21}	X_{22}
Baldwin	3rd	4 800	6 087	6395	11 28	71 1%	8.4	8.5	39.5	65.4	8.4	88.3	74.3	3.4	1 77%	7 %	15.2	29,705	77 5
Bibb	1st	4 730	1.44	14 561	1 1%	18.12	98.12	4 5	8.4	35 5	77 4	8.4	77.3	21.4	8.4	4 493	4 4	8.4	114 679	36.8
Bibb rest	2nd	4.428	4 31	4 18-8	745	20.06	111 28	1 5	8.4	36.4	79 1	7 4	88 4	8.4	4	1 031	4 4	8.8	26 740	48.8
Bacon	2th	4 320	5 29	4 297	821	18.3%	93.3%	1 4	8.8	31.3	67 4	3.4	77 4	12 4	1 1	629	4 4	4 4	23,458	4
Carroll	3rd	4.435	5 78	4 779	414	16.14	8.83	4 4	8.2	28.4	74 4	4 4	89 4	30.2	4 4	1 385	4 4	4 7	36.800	7 7
Catoosa	2nd	4.884	6 72	4 185	339	21.09	76.28	4.2	8.4	2 1	74.4	8.1	88.4	40.0	1 4	4 616	4 1	8.4	18,146	24 4
Chatham	2nd	4.648	4.43	20 282	1 383	14 56	43.82	4 4	1.8	36.8	82 4	8.7	47.4	23 4	8.4	4.385	7.3	8.7	141 881	28.8
Cherokee	3rd	4.709	4.88	4 800	691	23 82	79.66	1 4	8.4	4 1	91 4	8.4	88 9	48.4	4.8	1 693	4 4	4.1	20 730	7 1
Clarke	2nd	4.825	4 11	4.857	1 100	28.38	88 93	4.1	3.0	27.8	78.9	8.1	88.4	18.4	8.4	4 800	4 4	8.7	38.950	38.7
Clayton	4th	4 414	8.14	4.057	376	12 41	57 89	4 1	1 1	16.4	74 2	4 2	88 1	22 8	1 4	4 184	4 4	4.9	28 872	36.2
Cobb	2st	5.955	8.66	4 14	767	9.75	64 41	3.4	8.2	2 4	76.4	8.4	87.3	28.3	1 4	4 838	4 4	8.1	41 148	35.3
Covington	4 2	5.458	8 14	4.826	1 114	17.57	43.21	3.4	2.4	14.4	78.4	18.1	84 2	20.4	3.8	4 146	4 4	4.4	20 882	138.7
Dalton	4 4	6.72	1 38	5 114	895	31 35	85 78	1 4	8.4	34 4	80.2	8.4	83.3	28.4	1 4	1.722	4.5	8.7	25.961	31 4
Decatur	3th	6.830	8.41	5.077	696	21 49	98.76	2.4	8.2	38 4	76.4	4 1	86.8	18.4	1 4	1 499	4 4	4 4	23.830	8.4
DeKalb	4 4	4 66	4.98	14 386	1 332	11.26	38 88	1 4	4.2	4 7	82.2	4 4	91.8	18.4	8.4	4 186	4 4	8.4	114 766	63 1
Decatur city	2 4	6.708	8.84	2 241	1 800	14 88	4 1.66	1 4	4 5	14 4	92.8	12.4	88 1	12 2	8.4	4 1.4	4 4	8.8	41 436	36.4
Dougherty	2th	4 891	8 72	4.883	1 263	6.84	34.88	8.4	4 1	4.2	72.8	8.4	88 4	18.4	4 5	4 .42	4 4	8.4	43.414	38 7
Floyd	2th	4 724	4.38	4 761	567	17 41	38 76	4.8	2.9	9.4	73.2	8.4	87.6	27.2	1.8	4.332	4.8	8.8	33.894	1 4
Rome City	2th	6.389	8.59	4 752	1 128	14.05	58.41	4 4	2 4	28 4	76.4	8.4	88 4	4 1	4.371	8.4	8.4	28 814	17 2
Atlanta City	1st	1 264	8.66	46.481	1.489	12 38	17 65	3.4	4 4	28 4	78.4	9.5	42 4	15.8	4 4	4 868	4 4	8.4	581 314	8.4
Clayton	1st	4 913	8.89	7 462	868	34 66	4 .41	8.4	7.8	38.8	87 4	8.4	94 8	28.2	2.4	4.811	4 4	8.7	29.046	38 4
Spalding	3rd	4 276	4.34	4.514	814	12 75	63.46	3.4	1 1	27 4	76 9	4 4	66.6	15.7	1.8	4.433	4 4	8.4	41.496	9.4
Swinnett	2th	4 46	8.84	8.598	524	18.75	46 46	2.4	8.4	7 4	74.4	4 4	88 4	16.7	1 1	1 411	4 4	8.9	28 800	79.4
Troup	2th	4 584	8.88	5.885	728	24 88	88.35	4.4	8.4	2 4	72.8	4 4	84 4	27 2	1 4	1 887	4 4	8.4	38.172	16.4
Houston	3rd	4 846	8.88	3.738	432	4.88	78.41	4 4	8.4	35.4	68.8	8.9	87 4	8.2	1 4	4.473	4 1	4.1	20 946	85.3
LaGrange	3rd	1 193	8.72	4.314	1.886	26.14	37 93	3.8	1.9	38.6	71.8	4 4	93.3	38.8	2.4	4 263	4.6	8.8	26.781	13.4
Muscogee	1st	1 189	8.68	15.836	1 127	16.38	86.76	8.4	3.2	26.1	68.4	8.4	97 4	38.8	1 4	4 888	4 2	4.2	114.018	56.7
Newton	3rd	4.780	8.42	4.814	758	12 81	83 76	1.8	1 4	27 1	66 4	4 4	38 9	12 4	1 4	4 262	4 4	8.9	20 285	8.7
Richmond	1st	4 581	8.82	15.682	1 967	14 58	41 72	8.4	1 4	33.4	78.4	8.3	87 4	41 9	2.4	4.493	4 4	8.7	118 876	53.4
Ga Tech	2th	4 762	1.39	4.536	814	28 82	83 66	4 4	1.8	38.4	78 4	3.4	91 4	18.1	1 4	1.573	2 4	5.4	22 845	41 4
Valdosta	3rd	8.66	1 38	7 792	1 895	18.34	4 65	4.8	2.4	44 4	81.8	8.4	67.4	15.4	2 4	1 888	8.4	8.9	20 846	38.4
Walker	3rd	8.892	8.24	6.314	681	22 32	76.88	4.1	2.7	4.1	81 8	8.4	88.1	48.8	1 4	4 367	8.8	8.9	88 88	22.1
Whitfield	2th	4 296	1.14	4.860	767	21.66	84.93	4 1	8.4	4 7	74.8	8.4	78 4	38.1	8.4	1.961	2.8	8.4	14 976	18.4

TABLE 20

RAW DATA FOR DEPENDENT AND INDEPENDENT VARIABLES
KENTUCKY 1950

Counties	State Code	Dependent Variables Z_5	Z_6	Independent Variables X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8	X_{11}	X_{12}	X_{14}	X_{15}	X_{16}	X_{17}	X_{18}	X_{19}	X_{21}	X_{22}
Brown	201	0 253	0.42	1 008	859	16.30	39.08	1 0	0 0	1 0	80 0	0.0	17.4	18.0	1 0	0 186	0 0	10 1	11 660	80.7
Ash and	202	1 189	1 01	0.176	1 158	18.63	41 03	5.0	0 0	2.0	84 0	0.0	23.0	28.0	1.8	0 023	0 0	7 7	01 571	9.0
Campbell	203	869	0 82	1 406	1 783	10.68	39.08	3.0	1 7	1 0	84 0	0 0	97 0	91 0	1 0	0 804	5 0	8 0	10,265	7 0
Meyfors	204	1 046	0.50	7 898	1 231	9.34	55.01	0.0	1 0	0 0	84 0	8 0	30 0	35 0	0 0	2,737	0.7	0 0	37,864	0 0
Carter	205	1 273	0 44	0 004	447	22.10	50.07	0 7	0 0	0 1	71 0	7.6	10 0	30.0	0.4	1,406	0.2	0 0	22 595	+11 7
Christian	206	1 474	0 84	7 172	803	13.32	92 83	0 1	1 0	13 0	65 1	0.4	82 2	10.0	1 1	1 808	0 0	0 0	29,017	17.2
Clay	207	2 169	0.25	0 008	017	20.38	73.36	1 1	0 0	0 0	84.4	0 0	0 0	0 0	0.3	1 169	0 1	0.4	20 10	7 0
Daviess	208	1 343	0.83	2 502	906	13.33	80 45	4.7	0 1	5.1	77.8	0.0	28 0	26.0	1 0	0 023	0 0	0.4	21,590	9.0
Hopkins	209	1 307	0 70	0 134	1 221	12.80	69.80	5 0	0 7	7 0	76 0	0.0	34 0	32.0	1.6	0.481	0 5	0 7	33 051	11 0
Fayette	210	1 010	0 98	7 010	1 664	17.42	73.07	0 7	0 7	17 0	81 0	10.4	91 0	9.0	3.5	2,717	5 0	0 0	45 210	77 7
Lee ington	211	1 125	-0.86	0 008	1 537	15.00	39.38	0.0	0.2	36.0	81.4	9.8	36.4	8.8	3 0	1 635	11.4	10 7	33 736	17 0
Floyd	212	1 072	-0 15	0 008	587	21.84	51 43	5.0	1.8	1 0	66 1	0 0	10 1	0 0	0.4	1 837	0 0	0 0	19 308	1 0
Greenup	213	0 709	0 29	7 246	447	18.38	82 45	0 0	0 0	0 7	62 0	0 0	10 2	10 0	0 5	2,197	4 0	0 0	38,209	-0 1
Hardin	214	869	0 31	7 695	867	8.22	44.25	2.0	0 0	0 0	44 1	0.8	10.5	7.0	1 6	1 339	0.4	0 0	46 505	72 0
Marion	215	996	0 46	17 089	964	20.07	92 43	4.0	1 0	7 0	78.2	7 0	11 0	3.2	0 0	0 7 7	5.0	0 0	66 365	-4 7
Hopkins	216	1 327	1 01	7 975	961	17 18	47.22	5.0	1 1	5.0	76 0	0.0	10 0	9.0	0 9	1 726	0 0	0.0	05 208	2 7
Jefferson	217	1 251	0.30	10 965	1 582	12.56	87 77	0 0	7 0	2.0	83 3	0 0	31 0	30.7	2.2	2,852	0 0	0 0	117 486	25.0
Lawrence	218	1 186	0 14	77 339	1 682	9.34	60.07	0 0	10 7	83.8	9 0	34 2	81 1	1 0	2,287	0.3	0.3	33e 129	17 7
Lewis	219	868	0.58	7 860	1,830	11.46	48 10	7 5	1 7	0.0	80.0	0 3	36 0	27 5	1 0	0 867	5 0	8 5	20,334	11 0
Lincoln	220	1 018	0 01	0 483	1 384	8.51	64 10	4.0	0 0	5.0	78.0	0.8	33 0	28.7	0 0	0 831	0.1	0.0	28,438	0 0
Knox	221	1 185	0 01	0.917	350	18.81	91 01	5.0	0 7	1 7	48.3	7 0	10.2	0.4	0.7	1 069	5.7	0.0	00 487	-0.0
Larue	222	0 975	1 04	7 267	109	23 24	85 36	6.0	0 8	0 0	65 0	7 0	0 0	0 1	0.3	1 668	4.4	0 0	32 681	7 0
McCracken	223	1 039	0 01	7 749	700	10 91	40.77	4.5	0 1	2.0	81 1	0 7	29 0	21 1	1 0	0 158	0.4	0 5	10,369	1 0
Pendleton	224	961	1.06	0 566	1 220	10 31	39.38	5.0	0.8	6.0	83 1	0.0	32.0	20.0	1 0	0 172	0.0	0 0	32 825	9 8
Muhlenberg	225	1 250	1 01	0 868	581	19.36	85.71	3 0	0 0	5.0	75 7	0.0	11 7	0 1	0 0	1 334	0 7	0.0	25 730	73.0
Perry	226	888	95	7 546	593	20.30	69.71	0 0	0.5	0 0	66 0	7 0	11 7	0 7	0 6	1 851	0 0	5.0	39 581	7.6
Pike	227	0 422	0 10	14 018	378	22.10	96.88	0 0	8 8	1 0	69 0	7 0	10 4	0 0	0.4	1 810	5 0	0 0	76 000	10 1
Pulaski	228	1 306	1.49	7 810	1,885	10.69	60.64	1.9	0 0	2.0	66 0	0 0	10 0	0 0	0 0	1 191	0 0	7 7	01 365	3.8
Rowan Ing Green	229	1 184	0.84	7 197	840	11 80	37 99	5.0	0.2	73.8	80.8	0.0	36.6	14.0	1.8	1 366	0.6	0.0	18 347	85.0

TABLE 4B

RAW DATA FOR DEPENDENT AND INDEPENDENT VARIABLES

ILLINOIS 1950

State	Area Code	Dependent Variables Y_2	Y_3	Independent Variables at X_1	X_2	X_3	X_5	X_6	X_7	X_8	X_{12}	X_{13}	X_{14}	X_{15}	X_{16}	X_{17}	X_{18}	X_{19}	X_{21}	X_{32}
Alton	401	2 604	1 40	2 202	1 351	28 59	22 22	2 5	2 2	11 8	89 6	9 1	52 4	41 2	5 2	2 891	2 0	9 4	32 250	2.1
Aurora East	402	1 222	1 98	2 881	1 256	12 46	66 50	2 7	4 0	2 2	89 9	10 2	34 0	39 2	2 2	5 221	2 5	10 0	90 226	2 2
Aurora West	403	1 966	2.03	2,478	1 256	12 42	42 50	2.2	4 8	2 2	89.2	10 2	34.8	39 3	8 2	3,277	2 2	10.0	88 000	7 2
Belvidere	404	9.811	8.42	2 209	1 178	23 65	69 28	1 6	8 2	0.6	81 2	9.1	32 2	12 2	4 2	3 212	4 2	11.2	9,432	16.4
Bloomington	405	1 621	1 08	2,275	1 901	18 76	34 82	9.1	4 4	2.4	79.2	11.2	37 2	12 0	8 2	2 675	4 2	11 2	34 162	2 2
Champaign	406	1 219	0 76	4 021	1 372	18 16	21 88	2 5	5 5	8 5	90 2	12 2	36 9	9.2	19 8	1 611	8 9	2 5	39 962	69 8
Chicago	407	1 434	1 22	332 668	1 780	9.19	36.11	4 8	4 5	14 1	89.0	2 5	52.2	38 2	5 2	2 366	5 4	2 6	2 628 962	6 6
Danville	408	1 851	-1 56	2 811	1 588	12.41	62 40	4 6	2 6	0.1	86 2	9.4	34 1	24 2	2 1	2 875	2 2	11 4	37 544	2.8
Decatur	409	2 280	1 01	2 660	1 2 2	14 88	74 88	4 2	2 5	2 4	85 8	10 2	35 0	22 2	2 1	5 693	8 9	10 0	84 269	11 2
Elmhurst	410	2,664	0 65	2 000	1,499	12 36	38.12	3.1	2 2	1 4	93 2	11 3	34 4	26 1	2 2	2 287	2 2	11 4	11 522	69 8
East St Louis	211	2 434	1 18	11 866	1 276	14 67	22 97	4 1	1 8	33 5	88 8	8 2	30 2	22 8	2 8	2 222	8 2	2 7	88 295	8 8
Edwardsville	412	2 198	1 48	2 082	1 566	23 65	39.70	3.8	2 5	6.3	84 2	9.6	22 2	29.6	6 2	2 468	5 2	10.2	8 276	2.8
Elgin	413	2 001	1 19	2 364	1 732	12 13	48 26	2 1	4 1	1 9	91 2	10 2	32 8	21 1	6 4	2,496	2 1	11 6	44 222	19.4
Freeport	414	2,078	1 62	2,558	1 252	12 12	60.85	4 8	2 5	2 6	86 2	2 2	38 2	22 9	6 0	2 008	2 0	11 6	22 467	0 2
Galesburg	415	2 125	1 25	4 544	1 402	12 73	56 25	2 2	2 2	3.5	90 2	11.2	22 2	18 9	6 3	2 892	4 3	11 5	11 425	8 8
Jacksonville	416	1 464	1 26	1 582	1 362	2 45	91 46	4 3	3 4	5 1	92 8	2 1	36 1	12 9	8 5	2 105	5 6	12 9	28 182	2 2
Kankakee	212	2 165	8 62	2 082	1 238	11 65	38 42	4 1	5 5	5.0	86 6	9.0	22 1	34 9	5.1	2 202	5 1	9.8	22 856	16.2
Mattoon	218	2 256	1 21	2 190	1 254	12 32	75 90	2 2	6 9	0.9	87 2	9.8	22 2	21 8	4 6	2 363	2 2	10 5	12 342	10.2
Moline	419	1 862	0 86	5,869	1 742	12 53	66.32	6 4	4 1	0.6	90 2	10.2	22 2	48.4	6 8	2 621	2 2	10 1	12 382	8.1
Pearia	420	1 625	1.14	12 081	1 858	11 69	18.46	4 8	5 9	2 3	84.1	2 9	34 2	22 2	6 2	2 001	4 2	9.1	111 866	2 4
Quincy	221	1 734	0 62	4 382	1,479	13 58	27 11	2 9	5 9	2 9	90 2	8 9	22 9	34 4	4 9	2 212	5 1	12 6	41 450	2 4
Rockford	222	1 565	1.19	10 826	1,234	11 76	19.76	2 4	5 9	1 8	88 2	10 1	22 1	49 6	6 0	2 738	6 6	9 6	92 382	9.8
Rock Island	223	1 121	1 01	2 990	1 720	12 31	66,11	3.5	2 6	1.9	86 2	10 2	32.8	42 2	5 4	2 272	2 2	9 1	48 210	12.2
Springfield	224	1 720	0 92	2 216	1 642	11 38	40 82	4.2	5 0	3.3	86 6	10.2	32.2	60 2	6 0	2 312	2 4	10 5	81 628	8 1
Urbana	225	1 482	9 34	2,282	1 235	2 89	55 38	1 9	4.1	1.9	92 2	12 8	36 2	2 4	30 6	1 805	8 0	2.2	22,934	62.4
Collinsville	225	2 003	0 64	2 562	1 234	21 05	70 22	2 8	2 3	2 5	86 1	8 6	27.6	22 5	5 8	2 234	2 0	9 8	11 843	21 4
Granite City	222	2 222	0 34	2 058	1 128	12 17	79,56	4 1	1 2	0.1	84 2	8 2	25 8	48.2	3 4	5 221	4 2	6 6	22 465	28 2
Marion	228	2 131	-1 87	2 778	1 850	14 57	124 82	8 0	1 8	5 0	87 2	8 8	24.8	12 4	4 6	2 263	5 0	12 1	18 459	13.1

APPENDIX C

TABLE A1

FIRST ORDER CORRELATION MATRIX OF 1950 VARIABLES EXPRESSED IN RAW FORM

VARIABLE	$\bar{x}_5$	$\bar{x}_1$	$\bar{x}_3$	$\bar{x}_4$	$\bar{x}_2$	$\bar{x}_6$	$\bar{x}_7$	$\bar{x}_8$	$\bar{x}_{12}$	$\bar{x}_{13}$	$\bar{x}_{14}$	$\bar{x}_{15}$	$\bar{x}_{10}$	$\bar{x}_{11}$	$\bar{x}_{16}$	$\bar{x}_{21}$	$\bar{x}_{22}$	$\bar{x}_9$
x_3	1.000	-0.011	0.218	0.685	0.063	0.823	0.313	-0.66	0.331	0.298	-0.663	0.000	0.321	0.349	-0.155	0.428	-0.004	-0.949	-0.168
x_1		1.000	0.000	-0.198	-0.070	0.132	+0.234	0.032	0.120	0.000	0.129	0.076	0.096	0.162	0.283	-0.054	0.094	-0.004	0.099
x_2			1.000	-0.000	-0.334	0.033	0.797	-0.136	0.720	0.317	0.643	0.307	0.010	0.642	0.260	0.449	0.206	-0.000	0.203
x_4				1.000	0.333	-0.046	-0.814	0.000	-0.298	-0.503	-0.410	-0.110	-0.358	-0.318	-0.389	-0.390	-0.713	-0.095	-0.189
x_5					1.000	-0.084	-0.339	0.331	0.031	-0.000	-0.128	-0.427	-0.104	-0.451	-0.196	0.266	-0.097	0.263	-0.127
x_6						1.000	-0.030	-0.033	0.004	0.000	-0.000	-0.010	-0.129	0.007	0.105	0.010	0.106	-0.014	-0.158
x_7							1.000	-0.184	0.617	0.344	0.503	0.101	0.668	0.575	0.230	0.323	0.234	0.195	0.130
x_8								1.000	-0.163	-0.303	0.350	-0.288	-0.110	-0.483	0.389	-0.167	0.011	0.139	-0.063
x_{12}									1.000	0.686	0.463	0.170	0.536	0.479	0.125	0.562	0.123	0.000	0.120
x_{13}										1.000	0.313	-0.070	0.699	0.474	0.092	0.504	0.006	0.417	0.078
x_{14}											1.000	0.367	0.300	0.383	0.196	0.241	0.126	0.194	0.096
x_{15}												1.000	-0.039	0.581	0.029	0.442	0.097	-0.269	0.178
x_{10}													1.000	0.264	0.169	0.255	0.061	0.233	0.099
x_{17}														1.000	-0.022	0.169	0.171	0.006	0.078
x_{18}															1.000	-0.101	0.994	0.043	0.067
x_{19}																1.000	-0.086	-0.102	0.036
x_{20}																	1.000	-0.025	0.103
x_{22}																		1.000	-0.140
x_9																			1.000

TABLE B)

FIRST INVERSE CORRELATION MATRIX
OF 1000 VARIABLES EXPRESSED IN RAW FORM

VARIABLE	y_3	x_1	x_2	y_4	y_5	y_6	y_7	x_8	x_{12}	y_{10}	x_{11}	x_{13}	x_{14}	y_{15}	x_{16}	x_{17}	y_{18}	y_{19}	x_{21}	x_{22}	y_{5}	x_{6}
y_7	1 000	-0 112	0 636	0.186	-0 494	-0 213	0 388	-0 338	0 327	0.358	0 199	0 345	0 643	0 608	-0 343	0 664	-0 000	-0.032	-0 057	0.861		
x_1		1 000	0.476	-0.315	-0 164	-0 004	0 261	0.121	0 083	0 283	0.187	-0 020	0 644	0 159	0.134	0 002	0 000	0.115	0 134	0 355		
x_8			1 000	-0.318	-0 718	-0 644	0 271	-0 834	0 301	0 706	0 338	0 238	0 633	0 237	-0 557	0 326	0 264	0.131	0.106	0.087		
x_3				1 000	0 291	0 184	-0.171	-0 814	0 196	-0 264	-0 182	0 271	-0 188	-0 166	0.117	-0.169	-0 234	-0.103	-0.009	-0.377		
x_5					1 000	0.291	-0.629	0 235	-0 120	-0 284	-0 666	-0.647	-0.858	-0 685	0 243	-0 000	-0 188	0 138	-0 258	-0.649		
x_6						1 002	-0 872	-0 130	-0 368	-0 243	-0 663	-0.285	-0 345	-0 495	0 811	-0 1888	-0.005	-0.233	-0.343	-0.336		
x_9							1 000	-0.080	0.425	0.715	0.000	0.217	0.639	0.824	-0 282	0.875	0.249	0.246	0.14	0 269		
x_{10}								1 000	0.030	-0.154	0 387	-0.381	-0.118	-0.203	0.387	-0.125	0.080	0.027	0.073	-0.727		
x_{12}									1 000	0 480	0.498	0 126	0.362	0 384	-0 324	0.239	0.057	0.191	0.245	0 309		
x_{11}										1 000	0.118	-0.109	0 611	0.604	-0.591	0.183	0 165	0 514	0.083	0.549		
x_{13}											1 000	0 133	0 358	0 493	-0.145	-0.026	0 133	0 101	0.330	0.346		
x_{14}												1 000	-0 057	0 440	-0 065	-0.100	0 011	-0.188	0.296	0.257		
y_{15}													1 000	0 488	-0 495	0.170	0 045	0 177	0 113	0.237		
x_{17}														1 000	-0 606	0 004	0 162	0 146	0 153	0 230		
y_{18}															1 000	-0 279	0 101	-0 015	-0 005	-0.578		
y_{19}																1 000	0 020	0 077	0 003	0 438		
x_{21}																	1 000	0 056	0 030	0 170		
x_{22}																		1 000	0 128	-0.016		
y_5																			1 000	-0.007		
x_6																				1 000		

TABLE 88

FIRST ORDER CORRELATION MATRIX
OF 1950 VARIABLES EXPRESSED AS Z VALUES

VARIABLE	Y_5	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8	X_{12}	X_{13}	X_{14}	X_{15}	X_{16}	X_{17}	X_{18}	X_{19}	X_{20}	X_{21}	X_{22}	Y_3
X_5	1.000	0.038	-0.330	0.253	0.075	0.040	-0.041	-0.135	-0.150	-0.081	-0.136	-0.103	-0.096	0.121	-0.067	-0.051	0.009	0.144	-0.017		
X_1		1.000	0.784	-0.261	-0.265	0.250	0.333	0.031	0.101	0.136	0.217	0.094	0.103	0.011	0.155	-0.176	0.001	0.017	0.183		
X_2			1.000	-0.094	-0.038	0.053	0.232	0.161	0.010	0.079	0.150	0.117	0.062	0.051	0.049	0.187	0.010	0.123	0.206		
X_3				1.000	0.509	-0.076	-0.531	-0.161	-0.218	-0.549	-0.518	-0.095	-0.498	-0.108	-0.185	0.186	-0.186	-0.283	-0.096		
X_4					1.000	-0.175	-0.320	-0.139	-0.318	-0.495	-0.503	-0.185	-0.485	-0.417	-0.018	0.188	-0.800	-0.391	-0.082		
X_5						1.000	0.016	0.095	0.150	0.051	0.084	0.081	-0.079	0.198	0.196	0.908	0.230	-0.061	-0.106		
X_6							1.000	0.092	0.053	0.054	0.525	-0.208	0.696	0.478	0.358	0.091	0.163	0.251	0.080		
X_7								1.000	-0.155	0.101	0.406	-0.148	0.112	-0.376	0.178	0.073	0.118	-0.198	0.108		
X_8									1.000	0.576	0.120	0.082	0.810	0.824	0.093	0.266	0.175	0.287	0.091		
X_{12}										1.000	0.144	-0.097	0.800	0.444	0.190	0.041	0.196	0.557	0.088		
X_{13}											1.000	0.181	0.401	0.166	0.426	0.163	0.161	0.096	0.188		
X_{14}												1.000	-0.149	0.337	0.018	0.058	0.050	-0.187	0.198		
X_{15}													1.000	0.188	0.357	0.187	0.168	0.424	0.134		
X_{16}														1.000	0.016	-0.057	0.342	0.227	-0.008		
X_{17}															1.000	-0.020	-0.090	0.443	0.057	0.079	
X_{18}																1.000	-0.095	-0.378	0.016		
X_{19}																	1.000	0.044	0.186		
X_{20}																		1.000	-0.188		
X_{21}																			1.000		
Y_3																					

TABLE 44

FIGHT ORDER CORRELATION MATRIX
OF 1000 VARIABLES EXPRESSED AS D VALUES

VARIABLE	Σ_{11}	β_1	χ_6	χ_3	χ_5	χ_6	χ_7	χ_8	β_{10}	β_{13}	β_{18}	β_{15}	β_{16}	β_{12}	χ_{10}	χ_{19}	β_{21}	χ_{22}	β_5	β_4
ε_7	1.000	0.178	0.194	0.919	-0.366	-0.004	0.247	-0.036	0.600	0.001	0.127	0.001	0.013	0.232	-0.068	0.242	0.131	0.600	0.135	0.930
χ		1.000	0.000	-0.239	-0.381	0.054	0.350	0.191	0.092	0.056	0.196	0.003	0.187	0.000	0.261	-0.109	0.975	0.085	-0.063	0.196
ε_2			1.000	-0.350	-0.711	-0.256	0.781	-0.071	0.191	0.232	0.000	0.003	0.532	0.002	-0.229	-0.000	0.307	0.261	0.250	0.763
χ_3				1.000	0.524	0.194	-0.350	-0.057	0.101	-0.019	-0.215	0.078	-0.010	-0.303	0.110	-0.242	-0.332	-0.181	-0.152	-0.698
χ_5					1.000	0.138	-0.975	0.056	-0.101	-0.022	-0.381	-0.100	-0.566	-0.510	0.057	-0.118	-0.409	-0.213	-0.185	-0.730
χ_6						1.000	-0.375	0.056	-0.092	-0.230	-0.323	-0.055	-0.309	-0.326	0.110	-0.100	0.010	-0.176	-0.151	-0.282
χ_7							1.000	-0.191	0.000	0.217	0.000	0.130	0.647	0.000	-0.205	-0.170	0.296	0.529	0.171	0.000
χ_8								1.000	-0.000	-0.150	0.583	-0.290	0.005	-0.258	0.321	0.065	0.165	-0.000	-0.287	-0.043
χ_4									1.000	0.360	0.357	0.000	0.262	0.000	-0.192	0.073	0.020	0.000	0.152	0.121
χ_{12}										1.000	0.000	-0.049	0.687	0.000	-0.413	-0.317	0.065	0.491	0.106	0.492
χ_{14}											1.000	0.111	0.382	0.208	0.128	-0.000	0.317	0.034	0.087	0.366
χ_{15}												1.000	-0.288	0.810	-0.030	-0.010	0.012	0.131	0.044	-0.011
χ_{16}													1.000	0.272	-0.258	0.036	0.191	0.291	0.047	0.366
χ_{17}														1.000	-0.262	-0.195	0.000	0.549	0.205	0.537
χ_{18}															1.000	0.076	0.246	-0.366	-0.116	-0.130
χ_{19}																1.000	-0.058	-0.231	0.117	0.109
χ_{21}																	1.000	0.095	-0.030	0.448
χ_{22}																		1.000	0.000	0.000
β_5																			1.000	0.314
β_4																				1.000

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BIOGRAPHICAL SKETCH

Julian Monroe Davis was born September 15, 1922, at Macon, Georgia. In June, 1940, he was graduated from Lanier High School. He then studied electrical engineering at Georgia Institute of Technology until April, 1943, at which time he entered the United States Army and served as commander of a field radio company in the Far East. In September, 1946, he returned to his studies at Georgia Institute of Technology and in June, 1947, received the degree of Bachelor of Science with major in Electrical Engineering.

From then until October 1956 he served as an application engineer with Westinghouse Electric Corporation, assisting central station customers in Atlanta, Georgia, with power distribution problems, and electrical contractors in Nashville, Tennessee, with applications involving distribution systems for buildings. This period of service was interrupted, however, from December, 1952 to May, 1955, when he worked with two Certified Public Accounting firms: Cadwell Napier, Atlanta, Georgia, and H. E. Fourcher, Jr., Macon, Georgia, as an accountant. During this time, he passed the required examination to obtain certification as a certified public accountant.

From October, 1956 until July 1958, he was Assistant to the Director of the Engineering Experiment Station at the University of Florida, at which time he became the Director of Finance and Accounting of the University. His interest in administrative problems while in that

job led to part-time graduate study, and eventually into a full-time doctoral program in Educational Administration at the University of Florida.

Julien Monroe Davis is married to the former Marion Frances Grove and is the father of four girls. He is a member of Phi Delta Kappa Professional Education Fraternity, Phi Eta Sigma, Eta Kappa Nu, Tau Beta Pi, and Phi Kappa Phi.

This dissertation was prepared under the direction of the chairman of the candidate's supervisory committee and has been approved by all members of that committee. It was submitted to the Dean of the College of Education and to the Graduate Council and was approved as partial fulfillment of the requirements for the degree of Doctor of Education.

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